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FIFTIETH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

State Board of Agriculture,

TOGETHER WITH THE

FIFTEENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

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The State Board of Publication.

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State Board of Agriculture, 1903.

Members ex Officio.

His Excellency JOHN L. BATES.
His Honor CURTIS GUILD, Jr.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, V.S., *Chief of the Cattle Bureau.*
JAMES W. STOCKWELL, *Secretary to July 1.*
J. LEWIS ELLSWORTH, *Secretary from July 1.*

Members appointed by the Governor and Council.

	Term Expires
WARREN C. JEWETT of Worcester,	1904
WILLIAM R. SESSIONS of Springfield,	1905
FRANCIS H. APPLETON of Peabody,	1906

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1906
Barnstable County,	JOHN BURSLEY of West Barnstable,	1904
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1906
Bristol County,	WILLIAM A. LANE of Norton (P. O. Barrowsville),	1905
Deerfield Valley,	ARTHUR A. SMITH of Colrain (P. O. Lyonsville),	1905
Eastern Hampden,	O. E. BRADWAY of Monson,	1906
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1905
Franklin County,	JOHN S. ANDERSON of Shelburne,	1904
Hampshire,	A. M. LYMAN of Montague,	1904
Hampshire, Franklin and Hampden,	J. F. BURT of Easthampton,	1906
Highland,	C. K. BREWSTER of Worthington,	1905
Hillside,	J. W. GURNEY of Cummington,	1905
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1906
Hoosac Valley,	A. M. STEVENS of Williamstown,	1906
Housatonic,	CHARLES H. SHAYLOR of Lee,	1906
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1906
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1904
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1906
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1906
Middlesex North,	H. S. PERHAM of Chelmsford,	1904
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1905
Nantucket,	H. G. WORTH of Nantucket,	1906
Oxford,	W. M. WELLINGTON of Oxford,	1904
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1905
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1904
Union (Agr'l and Hort'l),	ENOS W. BOISE of Blandford,	1904
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1906
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1905
Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1904
Worcester South,	C. D. RICHARDSON of West Brookfield,	1904
Worcester County West,	J. HARDING ALLEN of Barre,	1905

THE FIFTIETH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

In accordance with custom and in the line of my duty as secretary of the Massachusetts State Board of Agriculture, I herewith present the fiftieth annual report.

The year has been generally prosperous to the agriculture of this State, and the outlook for agricultural improvement, progress and prosperity in Massachusetts was never brighter than to-day. This Board is on the outlook constantly for such advances in the methods of improved agriculture as shall bring comfort and beauty to the home and content and prosperity to the farmer. It has been alert and quick to protect the farmer in his productions, to investigate and urge the newer lines of safe advance in method and product, and to stimulate to experiment and achievement in developing and demonstrating an advanced agriculture for the benefit of the State. The 51 per cent increase in the cash value of the agricultural products of this State in the last decade is an indication that the State's interest in agriculture is for her profit, and the financial returns prove it to be a good investment. This advanced position should continue, and must continue with the best home market in the United States at our door. Nay, more! it should advance in the next decade beyond the last, for already the new elements to success in the country towns are reaching out to the benefit of the rural life on our hills and in our valleys. Practically speaking, the abandoned farm is a thing

of the past, except where the forsaking was a matter of circumstance, or an advance to agriculture.

Toward these ends the Board of Agriculture is moving in leading the intelligent investigator to the newer yet safer lines of production just before us. Look at the lectures and discussions of the winter meetings of the Board, and note the forward movement breathing in every one of them, and be convinced that this meeting is of very great value to the State.

In our institute work, to which your attention will be called later, we meet the farmers in more heart-to-heart talks, that are practical and effective. Their value is attested by the great number of requests for speakers we cannot grant because of the limit of the appropriation. While these institutes are given to each agricultural society, there are very many of them combined with the meetings of the grange, the farmers' clubs, the fruit growers' association, and they are carefully distributed to benefit agriculture the most possible, in every part of the State. Our speakers are carefully chosen by the committee in charge of this department to teach from practical knowledge in every line of practical farming, from greenhouse culture to forestry, from more profitable dairy farming to greater roadside beauty and improvement.

Changes in the Board.

As heretofore, changes in membership resulting from elections by the several societies will be noted in the report of the committee on credentials in the proceedings of the annual meeting. During the past year Dr. Austin Peters, chief of the Cattle Bureau, became an ex-officio member of the Board, under the provisions of Acts of 1902, chapter 116.

Members retiring at this time because of expiration of term of service or by resignation are: J. S. Appleton of the Nantucket Agricultural Society; Charles B. Benedict of the Housatonic Agricultural Society; Joshua Clark of the Middlesex North Agricultural Society; F. W. Sargent of the Amesbury and Salisbury Agricultural and Horticultural Society: Wesley B. Barton of the Berkshire Agricul-

tural Society; H. C. Comins of the Hampshire, Franklin and Hampden Agricultural Society; and Geo. P. Carpenter of the Hoosac Valley Agricultural Society. Mr. Oscar S. Thayer of the Manufacturers Agricultural Society of North Attleborough retires because of ineligibility of his society to further representation on the Board.

Meetings of the Board.

The annual business meeting of the Board was held at the office of the secretary on Jan. 7 and 8, 1902, and a special business meeting was held at the same place on January 30. Also special business meetings were held at Horticultural Hall, Boston, on July 22, and in connection with the public winter meeting at North Adams on December 3. The public winter meeting for lectures and discussions was held at North Adams, December 2–4.

The fiftieth anniversary of the organization of the Massachusetts State Board of Agriculture was observed at Horticultural Hall, Boston, on Wednesday, July 23, 1902. The Massachusetts Horticultural Society courteously proffered the use of their spacious halls for the occasion, and the anniversary was delightful in its associations and reminiscences, and profitable in its review of the work of the Board and of the progress made in the half-century of agriculture which its history covers, together with the Board's influence in the advance, and its position as a leading factor in the general progress that has marked the broad field of agriculture in the last fifty years, making this land the granary of the world and its exports eighty per cent agricultural. A full report will be found on pages 9–54 of this volume.

Agricultural Societies.

Again at the close of another year we must consider the returns from our agricultural societies, and take our bearings. The fairs have been held, and the reports of our inspectors will soon be read. The fairs were generally successful, as these returns will show. That the exhibitions were worthy and instructive was generally attested by the farmers attending and by the local press in its reports. I

had hoped to attend nearly every fair, to personally examine into all the detail of the workings of the management and the character of the exhibitions, and their agricultural value and instructive worth. Sickness stopped me in my work, and the later investigation was done by others.

Seldom does September pass without a liberal number of rainy days, and this year was no exception. Some fairs must be unfortunate in date, and a storm is sure destruction to the best-arranged programme, and a financial set-back to any society. Such societies must face the financial loss, and with courage face the uncertainties of the next season to recoup their losses. A series of such unfortunate dates discourages the society, and it is sad indeed if, like the sick, "we change the spot but keep the pain," and later look out at the bright sun of the former date, and from under an umbrella sigh for the old days again.

The societies are aided by the State, and this aid is very essential to the success of the fairs. It is a bright spot that gives comfort even to the dashed hopes from a rainy day. It is a wise provision for the improvement of her agriculture, and constant improvement and advance attest its wisdom.

The society owes, therefore, loyalty to the State, to the end that her laws for the guidance of these fairs shall be respected and enforced, not only to the letter but in their intent also. Our fairs suffer because, unintentionally perhaps, confounded with other agricultural fairs over which we have no control. This Board must watch carefully to preserve the good name of these institutions of the State over which we have control, and the inspector sent by this Board to examine and criticise does not do his full duty if he does not report any serious infringement of the salutary law of the State.

The Cattle Bureau.

It is a pleasing courtesy for this Board to note the accession to our number of the chief of the Cattle Bureau, Dr. Austin Peters. We do most heartily welcome him to our Board and to our counsels, and endorse and commend the

work done by this Bureau since it was created by chapter 116 of the Acts of 1902. We further thank the chief of the Bureau for his courtesy in giving information and consulting with the Board, in every way, according to the Board the courtesies of fellowship and the respect due to this body of which he is an ex-officio member. Personally as your secretary and to the farmers of the State it is only justice we should say that the State Board of Agriculture had no part in the drafting of this anomalous bill or its enactment, placing the Governor and Council superior to the Board in guarding the cattle interests: making this department a Bureau of one man: instructing it to report to the Board of Agriculture, yet giving the Board no right to criticise, question or amend the report. This peculiar condition is plainly illustrated in the criticisms of the press and of intelligent critics praising or censuring the Board for the work of this Bureau, when the praise or blame rests entirely on the chief, with the Governor and Council as his advisory experts in the protection of the cattle industry of the State: also in the numerous inquiries that come to the secretary of this Board, both from within and without the State, for information as to the work of this Bureau, which the secretary could not give but for the courtesy of the chief of the Bureau, who has kindly furnished information keeping your secretary in touch with existing conditions and with the success of his work.

This condition should be changed, and doubtless will be in the near future.

The Dairy Bureau.

To speak in praise of the Dairy Bureau of this Board is superfluous, — its work praises it and its faithfulness in the discharge of its duties. It would also seem almost personal, as the secretary of this Board is the secretary of the Bureau and its executive officer, and doubtless will continue to be so long as the Bureau exists. However, the secretary desires, before leaving his position, to express to you his appreciation of the painstaking labor of the members of this department of the Board in conducting and guarding this work from extravagance and loss for the best interests of

the State. The secretary has been present at nearly every meeting, regular or special, since he became your secretary, and therefore speaks with knowledge in approving the work and commending the faithfulness of this Bureau.

The secretary would suggest to the committee of this Board, to whom the revision of the agricultural laws is intrusted, the consideration of the improved efficiency of the Bureau which would come from the constituting of the secretary a member of the Bureau as well as its executive officer, as now provided, so there may be no question of his voting rights on all matters coming before it. Your secretary would further suggest to the same committee the wisdom of electing the members of this Bureau at the annual meeting, in place of their appointment by the Governor of this Commonwealth.

Nursery Inspection.

Section 1 of chapter 495 of the Acts of 1902 reads as follows: —

> The state board of agriculture shall annually appoint some person qualified by scientific training and practical experience, to be state nursery inspector, and he shall be responsible to the board for the performance of his duties as prescribed in this act. The said inspector may appoint such number of deputies, not exceeding three, as he may deem necessary or expedient.

In accordance with this act, the Board, at a special meeting held July 22, appointed Dr. Henry T. Fernald as nursery inspector, and his report will come before you. The condition of the nurseries of the State was indeed serious, and the work of inspection and destruction or disinfection by fumigation greatly needed. The work has been well done, and no certificate has been given except after careful examination, repeated if necessary, to insure perfect safety to the purchaser of nursery stock from any nursery within the State. We believe it is for the interest of the Board and this work that Dr. Fernald be continued as State Nursery Inspector.

The following amendments to the law should be inserted to perfect it: —

1. Stock sent into the State is now required by law to be accompanied by a certificate. No penalty attaches if transportation companies receive stock not so accompanied. A section should be added, requiring all transportation companies to refuse to ship stock not accompanied by an unexpired certificate under penalty.

2. All stock shipped in the State should be accompanied by certificate.

3. At present no officer is assigned to prosecute violations of this law. This should be corrected.

Committee on Changes in Laws.

The committee appointed at the last special business meeting of the Board held at North Adams to consider and report changes in the laws of the Commonwealth relating to agriculture and the agricultural societies has organized and begun its investigations. The work cannot be done hurriedly and be well done; a thorough revision and codification of the agricultural laws, with such changes as seem wise to meet the circumstances of the present and the needs of the future, is the intended work of this committee.

Farmers' Institutes.

The call for institute work during the year was greater than ever before, and so many were the calls that a deficiency appropriation will have to be asked for. This is in part accounted for by the fact that the deficiency of last year was taken from this year's appropriation, and also to the new ruling of the Auditor, separating the appropriations for lectures before the Board and for the dissemination of information in agriculture. These appropriations have formerly been used interchangeably, an overplus in the former making up for a slight deficiency in the latter. Nevertheless, the time has come when there should be an increased appropriation for institute work, as it must go forward and not backward, and our farmers are calling for these meetings with more and more of insistence.

During the year 1902, 120 farmers' institutes were held under the direction and control of this Board. All of the

societies represented on the Board, with the exception of the Massachusetts Society for Promoting Agriculture and the Worcester Agricultural Society, held the 3 institutes required, and 6 societies held 4 or more. There have also been 9 institutes held in sections of the State where there was no agricultural society having membership on the Board, and where there seemed an imperative call for such meetings. The average attendance of the institutes has been very good, being 104, against 107 last year, 91 in 1900 and 94 in 1899. At 3 of the meetings the attendance was 300 or over; at 12, from 200 to 300; at 39, from 100 to 200; at 36, from 50 to 100; and at 24, less than 50. There are a few societies which still need to improve their work in this line before they will be giving an honest equivalent for the assistance they receive. It is the constant effort of this office to bring about improvement in these societies, and it is a pleasure to record that several of those formerly in this class have done much better work the past year.

Insectivorous Birds.

I desire once again to recommend to this Board action to attract and protect the birds so essential to the success of the farmer's labors. There should be concert of action to make most effective the laws now on the statute books of the Commonwealth, to bring to punishment the violators and further to protect from cruel killing the larger birds. Snap shooting or shooting in the brush before the leaves fall should be provided against in every community. The number of wounded birds left to suffer necessarily appeal to us most strongly, and to protect them is our duty. The law is not what it should be, for travelling over our lands should not be considered a right to be prohibited, but a privilege to be conferred in every case; but to use what law we have, and to enforce it to prevent suffering, should be our desire as well as our duty.

Chapter 308, Acts of 1884, reads as follows: —

Section 1. Whenever the owner of any land shall conspicuously post on the same notices that shooting or trapping is pro-

hibited thereon, it shall be unlawful for any person to enter upon such land for the purpose of shooting or trapping without the permission of the owner.

SECTION 3. Whoever offends against any of the provisions of this act shall be punished by a fine not exceeding twenty dollars.

The lecture given by E. H. Forbush, ornithologist to the Board, at the recent winter meeting, giving the results of careful study of the habits of our "home birds," is delightful, giving us an insight into the life, habits and value of these bright, cheery, flitting friends of the farmer. To forget them or neglect to provide for them or to protect them is a positive loss to the farmer, for they are the most valuable insect destroyers, costing nothing, but bringing a wealth of song and joy to the country home.

PUBLICATIONS.

The following publications were issued by this office in 1902, and may be obtained on application: —

	Pages.	Number.	Date of Issue.
Nature Leaflet No. 12, ...	8	1,000	Feb. 26.
Nature Leaflet No. 13, ...	4	700	April 15.
Crop Report No. 1, ...	40	2,600	June 6.
Agriculture of Massachusetts, 1901, . .	791*	15,000	June 7.
Crop Report No. 2, ...	40	2,600	July 3.
Crop Report No. 3, ...	40	2,700	Aug. 4.
Crop Report No. 4, ...	40	2,700	Sept. 5.
Crop Report No. 5, ...	40	2,700	Oct. 6.
Crop Report No. 6, ...	40	2,700	Nov. 7.
Farmers' institute pamphlet, . . .	14	800	Dec. 16.

* Including fourteenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 219 pages.

There were also issued in pamphlet form "The shade-tree insect problem," by A. H. Kirkland, M.S., and "Massachusetts forestry," by Hon. Wm. R. Sessions, both being excerpts from the "Agriculture of Massachusetts," 1901.

Crop Reports.

The publication of monthly crop reports was continued in 1902, much as in previous years, and 6 in all were issued (May–October), aggregating some 240 pages of printed matter. The special articles included in these reports were: "Cucumber growing in Massachusetts," by Dr. Geo. E. Stone (illustrated); "Three common orchard scales," by Dr. H. T. Fernald (illustrated), reprint of May, 1901, crop report; "Beef production in New England," by Prof. J. W. Sanborn; "Some inexpensive ways of making farm poultry more profitable," by John H. Robinson; "Improvement of pastures," by Prof. J. W. Sanborn; and "Greenhouse construction and management," by Prof. S. T. Maynard.

Nature Leaflets.

But two nature leaflets have been issued the past year, namely, "Winter birds at the farm," by E. H. Forbush; and "Peach leaf-curl," by Dr. Geo. E. Stone.

Press Bulletins.

This present year an added work has been instituted in the office, with marked success. It is the preparing and sending out of abstracts or résumés of the important publications and monthly reports issued from the office of the secretary. These abstracts, bringing out the more important points and furnishing synopses of the articles, have been very generally accepted by the leading daily and weekly papers and most of the agricultural papers of this and other New England States. These bulletins, calling attention to the publications of the Board, have brought about a large call for the original articles, in addition to our regular mailing list of nearly 3,000 names. I am satisfied that this new work can be considerably enlarged, and a large influence exerted in advancing the newer ideas and

the better methods of agricultural development, besides interesting a larger number of our citizens to realize the variety of our work and its helpfulness. It is pleasant to know that farmers of leisure, the proprietor of the golf course, the owner of the potato field, the seeker after poultry profits and the enthusiast for roadside improvement and forestry, — all find here a central point for consultation and help; and not the least pleasant feature of this office, a balm for unjust criticisms, are the expressions of acknowledgment for suggestions given or success attained from following the lines suggested.

Legislation.

The legislation of 1902 having reference to the Board of Agriculture or to the agricultural societies was: "An Act making appropriations for sundry agricultural expenses" (Acts of 1902, chapter 103); "An Act to abolish the Board of Cattle Commissioners and to create a Cattle Bureau of the State Board of Agriculture" (Acts of 1902, chapter 116); "An Act to provide for the payment of a certain bounty to the Bristol County Agricultural Society" (Acts of 1902, chapter 202); "An Act to authorize the State Board of Agriculture to appoint a State Nursery Inspector and to provide for the protection of trees and shrubs from injurious insects and diseases" (Acts of 1902, chapter 495); a "Resolve to provide for preparing and printing an account of the brown-tail moth and of the best methods for destroying the same" (Resolves of 1902, chapter 42); a "Resolve to provide for the better protection of butter by the Dairy Bureau of the State Board of Agriculture" (Resolves of 1902, chapter 110); and a "Resolve to provide for an investigation and a report by the State Board of Agriculture as to the feasibility and probable cost of producing vaccine lymph at the Massachusetts Agricultural College, for free distribution within the Commonwealth" (Resolves of 1902, chapter 121).

Legislative Appropriations: Board of Agriculture.

Objects for which Appropriated.	1902.		1903.
	Appropriated.	Used.	Appropriated.
Bounties to societies, . . .	$19,000 00	$18,565 68	$19,800 00
Work of Dairy Bureau, . .	11,200 00	9,819 01	8,200 00
Salaries of secretary and clerks,	6,200 00	6,200 00	6,200 00
Printing 15,000 copies "Agriculture of Massachusetts," Pub. Doc. No. 4.	5,367 99	5,367 99	* 5,200 00
Dissemination of useful information in agriculture.	2,000 00	2,000 00	† 3,174 16
Travelling and necessary expenses of the Board.	1,500 00	1,500 00	‡ 1,550 83
State nursery inspection, . .	1,000 00	682 70	1,000 00
Incidental and contingent expenses.	800 00	800 00	§ 845 13
Lectures before the Board, etc.,	800 00	551 05	600 00
Travelling and necessary expenses of the secretary of the Board.	500 00	358 96	500 00
M-spikes for marking shade trees in cities.	–	–	100 00
Aggregates, ...	$48,367 99	$45,845 39	$47,169 12

* Estimated.
† $474.16 deficiency for 1902.
‡ $50.83 deficiency for 1902.
§ $45.13 deficiency for 1902.

The Legislature of 1902 also appropriated $8,000 for the expenses of the Board of Cattle Commissioners and $50,000 for exterminating contagious diseases among horses, cattle and other animals.

Importance of Agriculture.

In conclusion, let us not underestimate the importance of agriculture. The prosperity of the twentieth century must depend on the productive industries, and first in importance are the products of the soil. For the last decade 80 per cent of all our exports have been agricultural, and the exports of a nation represent the wealth of the nation. This ratio of export may not continue. What it shall be rests with the farmer of the twentieth century.

We need to realize the dignity of our calling; to promote these experiments which our State and nation are working out, and to realize the necessity for the work they are doing for this country; to encourage each and all who till the soil to do their best work, and to find in it the added profit; to inspire in the farmer the desire to excel, to cultivate the love of nature, to realize the grandeur and joy of working together with God, seeking out the subtleties of plant life, and multiplying and increasing His gifts for the sustenance of man.

We are proud of our State, its wealth, its resources, its productions; in columns of finance it ranks high; and yet these all must subserve one thing to be truly rich and prosperous, and that is, the conditions which produce strong, noble men and noble women, fully equipped to noblest purpose and to grandest aims; and the nearer to nature the child is reared, the purer the instincts and the more healthy the development on all lines. The nearer the child to nature, the better, the stronger the man. There is not a city in these States that is not richly endowed by the strength of country life infusing its every avenue.

God gave us the country and the love of country and the love of nature. The garden is the symbol of all that is best and sweetest from the day of creation to the present moment. The garden is hallowed by the life of our Lord, — bright and happy, sad and bitter experiences, all found zest, solace and strength there. The hills were His teachers, the wheat was a lesson, the birds were companions and He cared for them. When we take His created things, so dear to the Divine heart, and multiply them as the wheat, beautify them as the lily and the rose, create new varieties, new bounty, new beauty, we are walking so near to God that the very thought of His joy in our endeavors must lift us to higher altitudes and more joyous work. Life is lifted by its surroundings, and nature was made so delightful, so beautiful and so improvable, as a ministry, elevating, ennobling and refining. Therefore must this communion with nature ennoble man, uplift and deify character, so long as the world shall endure.

And, second, the element of education or greater knowl-

edge must come to our aid. We talk of nature studies, and this is well. Electricity is but a study of nature's forces, and we are yet in the primary class in its wonderful uses. Chemistry has done much for us, and yet science's laboratory is so clumsy when compared with the alchemy of nature's crucible. In our chemistry there are mistakes, there are undiscovered potencies; in nature there has been no change, only greater development and grander results. How wonderful the choice — yes, let us call it the intelligence — hidden in the ground. What teaches the tree to select the soil food that shall produce the leaf, the blossom and the fruit in their season? Take a bit of earth in your hand, pulverize it, sterilize it if you please, then plant in it three little germs of life, and from that soil will come forth the grain for food, the flower, with its fragrance, and the plant with poison in its touch or taste. Who taught these different rootlets to select, collect and diffuse in plant growth such different elements? There is yet much before us to be solved ere we give up nature study or solve the chemistry of plant growth.

Flower in the crannied wall,
I pluck you out of the crannies; —
Hold you here, root and all, in my hand,
Little flower — but if I could understand
What you are, root and all, and all in all,
I should know what God and man is.

The progress made in agriculture and horticulture is not sufficiently well known. We do not fully appreciate what is being done by the United States government, supplemented by our experiment stations and adapted to our conditions. The farmers of the United States, the farmers of our State, do not realize the great and in some respects wonderful work that is being done for them and through them to the individual, the State, the nation and the world by these investigations, experiments and successes. We used to believe we must work in accord with the climate, and it was well. It was a part of the success of the past; but to-day the gardeners make the climate, change the character of the product, acclimatize the plants, change the

conditions, raise crop succeeding crop in rapid succession, make the soil they want for each special crop, fertilize and cross-fertilize as they desire, sterilize the soil to a wonderful increase of growth and productiveness, produce forage or seed at will almost, and all this is but the beginning of the new era of this new century. True, we may say, with Tennyson: —

> Little flower — but if I could understand
> What you are, root and all, and all in all.

Nevertheless, we are coming nearer to the heart of nature's forces, and the new varieties of fruit and grain, the new colors of foliage and flower, the improvement year by year, are proof of our creative power.

The development of agriculture in the last half-century has been a wonderful illustration of its future possibilities and promise. The natural resources brought to our aid, and that science seizes upon and adapts to our uses; our experiment stations, and the practical results being wrought by and through them; the agricultural knowledge attained at our agricultural colleges, and working its results in actual operation with our progressive farmers; the new departure of proved value in the production of crops, — each and all, working together, have so largely outrun the increase in population that we look upon the present century, with its threefold increase, not only sure that the agriculture of this country will meet its demands, but that it will at its close stand as to-day, the granary of the world.

To the members of this Board I am under very great obligations for your constant friendship and cordial support. If the Board has done good work, as I believe it has, to you must be given the meed of praise, for you have cordially sustained every endeavor and actively aided every advance; and now I leave the Board just at the beginning of a new half-century, in which its work should be so valuable, not alone to the farmers but also to the State. As I have suggested, new avenues open before us, new obligations are resting upon us, and I have no fear but Massachusetts will stand, under the leadership of this Board, as she does to-day,

in the first place in the experiments to be demonstrated, and the improvements that shall be valuable, and in the laws that shall be wholesome. Asking no favors as farmers, and allowing no discrimination without vigorous and united protest, until the right shall obtain and equality of burden and equality of privilege be the law of the State and the right of all its people.

The changed conditions of to-day working out their legitimate result, — the rural mail delivery, the electric roads, the enlarging uses of electricity, the improved methods and more profitable returns, the home market, the best in this country, — are fraught with benefit to the farmers of the State. No man is more enterprising than the farmer, as he feels the thrill of prosperity. His home has lacked comforts, his buildings have lacked neatness, his roadsides have lacked beauty, because the burden of labor was too heavy and the returns for his toil too meagre. He was disheartened and discouraged, and a disheartened and discouraged man can never develop into the best citizenship. The change in the last decade is marked, and every incident of farm life shows the improvement, and I believe it is to continue to improve for the advantage of the towns and the benefit of the State. And you of this Board, representing more than 27,000 of the leading, progressive agriculturists of the State, members of these societies that you represent, will and must carry forward this work. You represent the enterprise that has made our fairs instructive and helpful, that has instilled into farming of the State the newer and better ideas, the new and improved product, and demonstrated the way to more profitable returns.

Hold your societies to the primal thought of advancement and improvement of agriculture. This Board is and must continue to be *the department of agriculture for this Commonwealth*, not only for the improvement of its methods and products, but for safeguarding of its funds and wisely administering its laws for the benefit of the agriculture of the State. Helpful and efficient as it has been in the past, it must assume these responsibilities, and its wisdom

in counsel and faithfulness in the discharge of its obligations acceptably to the State and to the agriculture of the State will lead to its greater usefulness and enlarged responsibilities.

The State is looking to you for this result. It is for this she entrusts to you her aid, assured of its judicious and commensurate return in the greater prosperity enriching the valleys and crowning the rugged hills of this State. How worthy and how inspiring! And as I resign the position at the close of my present term, I am sure a stronger leader shall take my place to carry forward the work of the office, and I bespeak for him your wise counsels and as cordial support as you have given me. I cannot ask for more.

J. W. STOCKWELL,
Secretary of the State Board of Agriculture.

BOSTON, Jan. 13, 1903.

Summary of Crop Conditions, 1902.

The season was considered in advance of the normal at the beginning of the month of April, but by the close was about normal in most sections. Pastures and mowings suffered from drought, and it looked doubtful whether, even with favorable weather, the hay crop could recover from the check. Fall seeding did not winter as well as usual. The fruit bloom was very heavy, and the frosts of the month did little damage to fruit. Insects were doing but little damage. Spraying appeared to be barely holding its own among farmers. Wages averaged $20 per month with board and $1.50 per day without board. A considerable increase in the acreage of corn was noted, and a slight one in that of other grains and of potatoes.

Insects did but little damage in June, the cold weather perhaps operating to hold them in check. Indian corn was very small and backward, with, however, little complaint as to stand and color. Haying had hardly begun, and a short crop was expected. The acreage of early potatoes showed a slight increase, and the vines were looking extra well, though perhaps a little backward. Early market-garden crops had generally done well, with prices a little above the average. Dairy products appeared to be normal as to quantity, with a general increase in prices; dairy cows in good demand and at high prices. Pastures were generally looking well, although feed was still short in some cases. Strawberry picking was well under way, with the prospect of only a fair crop. Apples promised well, with Baldwins below other varieties; pears light; peaches above average; plums promised a good crop.

In July much less than the usual amount of damage from insects was reported. Indian corn was fully two weeks

late, and badly in need of warm, growing weather. Silos continue to gain in favor. The excess of rainy weather made haying progress very slowly, but improved the crop in quantity beyond what had seemed possible; quality generally good, but with much damage from rain. Rather more forage crops than usual had been planted, and they were in excellent condition. Market-garden crops grew well, with prices better than usual. Very few potatoes were dug at the time of making returns, but the crop promised well, with prices well sustained. Apples promised a good crop, though not a record one; pears light; peaches above the average; plums fair crop: grapes set heavily; cranberries set well. Pastures were never in better condition at the time of year. Rye, oats and barley generally promised well.

The cold nights of August retarded the corn crop still further, and not more than a partial crop seemed a possibility. Rowen promised a heavy crop on early cut fields, but not more than an average crop on all fields. Late potatoes were generally attacked by blight and rot, but where these did not appear yielded well. The acreage of tobacco was slightly increased and the crop was a fine one, though somewhat late. Apples promised a good crop, but Baldwins did not promise as well as other varieties; pears very light; peaches uneven, but not far from an average crop; grapes promised well; cranberries a light crop in south-eastern sections. Pastures were generally in excellent condition. Oats were an exceptionally good crop; barley not more than an average crop.

The frosts of the first week of September severely injured corn in many sections, and on the whole the crop was one of the poorest ever secured. Rowen was somewhat below an average crop, owing to late cutting of the first crop, and the dull weather was very unfavorable to securing it. Less than the usual amount of fall seeding had been done, but it was in good condition. Onions were less than an average crop, with prices very satisfactory. The yield of potatoes was shortened by rot, but not as much as had been feared. Root crops were generally in excellent condition. Celery was a good crop, and other late market-garden crops were generally fair. Apples improved much during the month,

and a good crop was assured; pears very light; peaches above average in yield; grapes a heavy crop, but not ripening well; cranberries a light crop.

Reports from correspondents the last of October showed that in localities where early frosts occurred Indian corn was almost a total failure, both for grain and stover. Elsewhere a partial crop of both was secured, but in all localities there were many fields which made very poor yields. Probably the value of the crop was not far from two-thirds of the normal, taking all parts of the State into consideration, and also considering the value of the grain and stover and of that portion of the crop raised for ensilage. Root crops generally proved to be good average crops. Potatoes were a light crop as a whole, owing to rot, but very good prices prevailed. Celery was a very good crop. Feed in pastures continued good throughout the season, and farm stock was reported almost invariably to be in good condition for the winter. Less than the usual amount of fall seeding was done, but that put in early made good growth. Late seeding made a good catch, but was somewhat backward at the close of the season.

Of the 141 correspondents answering the question in regard to prices received for crops raised for market, 70 spoke of them as average, 66 as higher than usual and 5 as lower than usual. The general trend of prices seemed to have been upward, shortages in particular crops doubtless operating to increase the movement. There was the usual diversity of opinion among correspondents as to the crops which proved most profitable; 62, less than a majority, united on potatoes; 41 considered hay to have been among the most profitable crops; 32, apples; 10, oats; 8, corn; 7, tobacco; 7, cranberries; 6, cabbages; 6, sweet corn; 6, strawberries; 4, onions; 4, tomatoes; 4, beans; and 4, fruit. Sixty-four correspondents — an unusually large number to unite on any one crop as among the least profitable — spoke of corn as among the least profitable crops; 27, potatoes; 9, hay; 7, tomatoes; 6, apples; 4, squashes; 4, cabbages; 4, sweet corn; 3, cranberries; 3, milk; and 3, beans.

Judging from the returns of correspondents, the season of 1902 was not an unprofitable one for our farmers as a whole, although perhaps not up to some recent years for profit. Corn and potatoes were the only principal crops to show a shortage, and in the case of the latter good prices somewhat compensated for the decreased yield. Good prices received for most crops, together with quick sales, were factors making for profit.

Of the 144 correspondents answering the question as to the profits of the season, 62 considered it to have been profitable, 11 as above the average for profit, 16 as average for profit and 18 as fairly profitable, while 37 thought that it had not been a profitable season.

Massachusetts Weather, 1902.

[Compiled from Data furnished by the Weather Bureau, Boston.]

The weather during January was uneventful and unusually pleasant for the midwinter season. There was much sunshine and precipitation in measurable amounts on an average of eight days. The precipitation was below the average in all sections, although it was quite well distributed. The chief feature in connection with this element was the snowfall, which was far below the average for this month. The average for the State was 8.5 inches, which is several inches below the usual amount for January; but, owing to the uniformly low temperature, the mean of which was 1.5° below the normal of the month, the ground was well covered with snow, giving good sleighing most of the period. The temperature conditions were very favorable to ice interests, and the weather generally adapted to out-door industries

The weather of February was of the type usually experienced during this month. There were several storms of marked intensity, accompanied by general and heavy precipitation, with high winds and gales. The most conspicuous of these occurred on the 2d and 17th. The rain and attending high temperature caused a rapid melting of the snow on the ground, and the result was swollen rivers and streams. Fortunately, the depth of the snow was not great,

and the damages from high water not great or general. The monthly precipitation was nearly 2 inches above the normal. The temperature ranged near the seasonal average, without notable features in the extremes.

March was generally unseasonable, some of the weather elements departing greatly from the monthly average. The most important departures were in the temperature and the precipitation. The monthly mean of the former was 8° above the normal, and in some localities the excess amounted to 10°. The excess in precipitation was less marked, although general in all sections. The snowfall, as in the preceding month, was light. At the close of the month the season was, according to the general estimate, from ten days to three weeks in advance of the average.

Generally speaking, April was a pleasant month. The weather was mild, with the temperature above the average, the excess amounting to about 2°. There was less than the customary amount of sunshine, but notwithstanding the extensive cloudiness, rain fell on an average of but nine days. The monthly precipitation was somewhat above the normal, the amounts ranging from 1 to 2½ inches. There was no snowfall worthy of mention, the amounts being generally too small to measure. Thunderstorms were of general occurrence on the 26th and 30th.

May opened with an excess of cloudiness, and the rainfall for the first week averaged more than an inch. Owing to the general dampness, the week seemed cool, though the average temperature was several degrees in excess of the seasonal. A cool wave occurred on the 10th and 11th, and caused very general frosts, which, owing to high winds, were not generally destructive. The precipitation during the second week was below the average. The nights of the third week were notably cool, with light frosts in many sections. There was, however, an abundance of sunshine and a corresponding deficiency in the amount of rainfall. The weather during the closing days of the month was without special or unusual features. The nights were cool in the first part of the period, but these were followed by some warm days, the temperature on the 23d rising to almost unparalleled figures for the season.

June opened with several warm days, and the weather conditions were very favorable and seasonal. The temperature during the first and second days ranged in the 90's in many sections. Before the close of the first week, however, there was a sharp drop in the mercury, and the weather was cooler than is usual for the season for the remainder of the month. The nights were, as a rule, exceptionally cool, and there were reports of light frosts in some localities. During the first ten days of the month the rainfall was quite equally distributed, and the conditions as regarded moisture were near normal. From the 10th to the 22d little rain fell in the eastern sections of the State. Copious showers and rains occurred during the closing week of the month in nearly all sections, and the droughty conditions were relieved. A conspicuous feature of the weather was an absence of the usual number of thunderstorms. Viewed as a whole, the weather of the month was unusually cool, but very pleasant.

The rainfall of the first week of July was seasonal and not in excess, but, owing to the uniformly low temperature, more sunshine was needed. The week ending the 14th was somewhat changeable, but the weather was generally fair, with a larger per cent of sunshine and a corresponding increase in temperature, although there was general complaint of cool nights. From the 15th to the 22d the weather was quite seasonal. The temperature was somewhat below the weekly normal, but the departure was unimportant. The closing week of the month was exceptionally unfavorable. The skies were almost continuously overcast, with frequent light rains and showers. The temperature, owing to cloudiness and ocean winds, was low. The month as a whole was abnormally cool, with much unpleasant weather.

August opened with several days of typical "dog day" weather, with a large excess of humidity and temperatures ranging in the 80's. From the 6th to the 12th inclusive the weather was unsettled, showers and local storms were prevalent, and the rainfall in some localities was considerably in excess of the average. The temperature during the time was quite uniform, rising but little above 80°. The nights

were especially cool, the temperature conditions being mostly unfavorable to vegetable growth. Fair weather, during which there was much sunshine, obtained from the 13th to the 18th. The temperatures, however, remained unseasonably low, the daily means ranging from 1° to 6° below the normal. The weather during the remainder of the month was rather uneven, but for the whole State the temperatures were notably below the seasonal averages. Summed up as a whole, the weather of the month was phenomenally cool. The rainfall of the month was generally deficient, although well distributed, and there was little if any complaint of dry weather. There was less than the usual amount of sunshine, but this was also fairly distributed through the month.

September opened with warm, sunny weather. The temperature ranged from 5° to 10° above normal for the first four days, rising to the 90's in many sections on the first and second days. General rains followed on the 4th and decidedly lower temperature by the 6th, when frosts occurred in many sections of the State. The cool weather was of short duration, the temperature climbing to the 80's during the 8th and 9th, when it ranged several degrees above the seasonal average. The high temperature was, however, of short duration, the mercury falling to the 50's on the 10th. The remainder of the month was slightly cooler than the average, except from the 21st to the 23d, when there was a slight excess in the temperature. While the weather of the month was characterized by much cloudiness, and light rains fell on many days, the rainfall was deficient, the amount being about half of the normal fall for September. A conspicuous feature in connection with the weather was the absence of general or severe storms and extended "northeasters," which are usually experienced at this season of the year. The frosts that occurred during the month were generally light, and, except in favorable localities, not sufficiently heavy to stop vegetable growth or kill vegetation, except of the very tender varieties. Taken as a whole, the weather of the month was very favorable to harvesting and securing crops, to fall seeding and to farm operations in general.

The weather of the month of October was devoid of conspicuous features in any of its several elements. There was an average amount of sunshine and pleasant weather, and also about the usual number of days on which rain fell. The rainfall was practically normal in amount, and quite equably distributed through the month. General rains fell on the 1st, 6th, 12th and 28th, and light showers on several occasions between those dates, which maintained a very seasonal condition of the soil. The temperature ranged above the average for nearly the whole of the month, although the excess was not marked at any time. At Boston the excess averaged about 2° per day. The first general killing frost, one to reach all sections, occurred on the morning of the 22d, which is about the average date. Snowflakes were observed in the air, at Boston and its vicinity, on the 29th, which was the first of the season. While this was earlier than the usual or average for the "first snow," it has occurred as early in other years.

November opened with clear weather, and the skies were generally sunny through the first four days of the month. This was followed by much and persistent cloudiness, but mostly without precipitation. While the skies were overcast for more than half of the days in the month, the average precipitation for the State was about one-third of the normal fall of the month. The chief storm, and the only general one that passed over the State, was on the 26th–27th. The remaining precipitation was in light amounts, and occurred with local disturbances. The temperature was much above the normal, the daily means being from 3° to 5° above the daily normals. The temperature was also very evenly distributed over the territory and through the period, there being no abnormally high or low readings during the month. The month as a whole was exceptionally mild and pleasant.

December, the first winter month, was unusually severe, the weather being characterized by heavy and destructive storms and severe cold waves. Excepting a few days at the opening, and the week from the 16th to the 22d, the temperature ranged almost continuously below the seasonal average. The monthly mean temperature was about 2° below

the normal. The cold wave of the 8th, 9th and 10th was of marked intensity, the temperature records in many sections breaking all previous records for that portion of the month. The mercury fell to zero in all sections, and for a large portion of the State the temperature readings were the lowest of authentic record. At Boston the lowest temperature was 8° below zero, which is the lowest of record for the first fifteen days of December within the period of official records, covering fifteen years. The precipitation, mostly in the form of snow, was fully up to the average, and in many instances it exceeded the monthly normal. Severe gales were experienced along the coast, resulting in more or less damage to shipping and some loss of life. There was less than the average amount of sunshine, more than half of the days of the month being cloudy, with rain or snow. The month will go on record as one of the most severe of its name.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

Annual Summary for 1902.

Pressure (in Inches).

Maximum reduced to freezing, 30.42, December 15. 10 A.M.
Minimum reduced to freezing, 28.54, February 17, 11 P.M.
Maximum reduced to freezing and sea level, 30.75, December 15, 10 A.M.
Minimum reduced to freezing and sea level, 28.86, February 2, 6 P.M., February 17, 11 P.M.
Mean reduced to freezing and sea level, 29.954.
Annual range, 1.89.

*Air Temperature (in Degrees F.).**

Highest, 91.0, May 23, 4 P.M.
Lowest, —15.0, December 10, 1 A.M.
Mean, 47.3.
Mean of means of max. and min., 47.2.
Mean sensible (wet bulb), 43.1.
Annual range, 106.0.
Highest mean daily, 79.0, July 9.
Lowest mean daily, —6.0, December 9.
Mean maximum, 57.6.
Mean minimum, 36.9.
Mean daily range, 20.7.
Greatest daily range, 54.0, December 10.
Least daily range, 3.0, November 27.

Humidity.

Mean dew point, 37.7.
Mean force of vapor, .402.
Mean relative humidity, 71.6.

Wind.—Prevailing Direction North-west.
Summary (Per Cent).

West, 12.
East, north-east, 10.
West, south-west, 10.
North, 9.
North-west, 9.
Other directions, 50.
Total movement, 48,438 miles.
Greatest daily movement, 596 miles, March 19.
Least daily movement, 3 miles, December 7.
Mean daily movement, 132.7 miles.
Mean hourly velocity, 5.53 miles.
Maximum pressure, per square foot, 24.0 pounds = 69 miles per hour, February 3, 4 P.M., N.N.W.; March 19, 3 P.M., E.N.E.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 46.99.
Number of days on which .01 or more rain or melted snow fell, 144.
Snow total, in inches, 57.0.

Weather.

Mean cloudiness observed, 60 per cent.
Total cloudiness recorded by sun thermometer, 2,589 hours = 58 per cent.
Number of clear days, 73.
Number of fair days, 113.
Number of cloudy days, 179.

Bright Sunshine.

Number of hours recorded, 1,861 = 42 per cent.

Dates of Frosts.

Last, May 14.
First, September 6.

Dates of Snow.

Last, April 2.
First, October 29.
Total days of sleighing, 44.

Gales of 50 or More Miles per Hour.

February 2, 60 miles, N.N.W.; February 3, 69 miles, N.N.W.; March 19, 69 miles, E.N.E.; April 27, 53 miles, N.W.; June 3, 50 miles, E.N.E.; June 26, 55 miles, N.; December 8, 50 miles, W.S.W.

* Temperature in ground shelter.

J. E. Ostrander, *Meteorologist.*
S. C. Bacon, *Observer.*

SPECIAL BUSINESS MEETINGS

OF THE

BOARD OF AGRICULTURE,

1902.

SPECIAL BUSINESS MEETINGS OF THE BOARD.

A special business meeting of the Board of Agriculture was held at Horticultural Hall, Boston, July 22, 1902, at 9 o'clock A.M., First Vice-President Wm. R. Sessions presiding.

Present: Messrs. Anderson, F. H. Appleton, Avery, Barton, Boise, Bradway, Brewster, Bursley, Carpenter, Comins, Damon, Danforth, Ellsworth, Goodell, Goodspeed, Gurney, Hersey, Jewett, Kilbourn, Lyman, Peters, Pratt, Reed, Richardson, Sargent, Sessions, Smith, Spooner, Stockwell, Thayer, Turner and Wellington.

The appointment of a State nursery inspector, under the provisions of chapter 495 of the Acts of 1902, being in order, Dr. Henry T. Fernald, professor of entomology at the Massachusetts Agricultural College, was unanimously elected to that position.

Chapter 121 of the Resolves of 1902, being a "Resolve to provide for an investigation and a report by the State Board of Agriculture as to the feasibility and probable cost of producing vaccine lymph at the Massachusetts Agricultural College, for free distribution within the Commonwealth," was the next matter of business in order, and it was voted that it be referred to the committee on Agricultural College and education, with instructions to report to the Board at its annual meeting in January, 1903.

Dr. Austin Peters, chief of the Cattle Bureau of the Board, presented and read the semiannual report of said Bureau, provided for under section 3 of chapter 116 of the Acts of 1902, which report was accepted and referred to the executive committee.

A special business meeting of the Board, in connection with the public winter meeting, was held at North Adams, Dec. 3, 1902, at 9.30 o'clock A.M., First Vice-President Sessions presiding.

Present: Messrs. Allen, Anderson, J. S. Appleton, Avery, Barton, Benedict, Boise, Bradway, Bursley, Clark, Comins, Damon, Danforth, Ellsworth, Goodell, Goodspeed, Gurney, Hersey, Jewett, Kilbourn, Lyman, Peters, Reed, Richardson, Sargent, Sessions, Smith, Stockwell, Thayer, Turner and Wellington.

The request of the Spencer Farmers' and Mechanics' Association for the approval by the Board of Agriculture of its vote, passed at the annual meeting of the association, on Nov. 13, 1902, "That the president and secretary, with the approval of the finance committee, be instructed to negotiate a mortgage for $2,000 to secure the indebtedness of the association," being in order, the matter was considered.

The delegate of the association was present, and stated the reasons for the mortgage. It appearing that the meeting at which the vote to mortgage was passed was legally called and held, that the vote was unanimous, that the hearing on the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the above-quoted vote of the Spencer Farmers' and Mechanics' Association, in accordance with the provisions of Revised Laws, chapter 124.

The request of the Weymouth Agricultural and Industrial Society for the approval by the Board of Agriculture of its vote, passed at the annual meeting of the society, on Nov. 13, 1902, "To increase the mortgage debt of $1,000 to $2,000," being in order, the matter was considered.

The delegate of the society was present, and stated the reasons for the increase of the mortgage. It appearing that the meeting at which the vote was passed was legally called and held, that the vote was unanimous, that the hearing on

the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the above-quoted vote of the Weymouth Agricultural and Industrial Society, in accordance with the provisions of Revised Laws, chapter 124.

The request of the Bristol County Agricultural Society for the approval by the Board of Agriculture of its vote, passed at the annual meeting of the society, on Nov. 22, 1902, "That the treasurer be and hereby is authorized to borrow the sum of $5,000 for the purpose of discharging the present indebtedness of the society incurred by the recent addition to the stables and other expenses of the past fair, and to mortgage real estate of the society to secure such loan, and that the delegate of this society to the State Board of Agriculture be authorized to petition that organization for authority to so mortgage," being in order, the matter was considered.

It appearing that the meeting at which the vote was passed was legally called and held, that the vote was unanimous, that the hearing on the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the above-quoted vote of the Bristol County Agricultural Society, in accordance with the provisions of Revised Laws, chapter 124.

Voted, That the Board express feelings of regret at the necessity for the above actions, with a word of caution to all societies that their expenses be kept down so far as possible.

A letter having been read announcing the illness of the second vice-president, it was

Voted, That the first vice-president be instructed to write to Mr. Pratt, expressing to him the sympathy and love of the Board.

On motion of Mr. J. L. Ellsworth, it was

Voted, That a committee of five, including the Chair, be

appointed, to consider the laws relating to agriculture and agricultural societies, to report at some future meeting of the Board, and with power to recommend to the Legislature such changes in the present statutes as shall seem in their judgment expedient.

The committee was constituted by the appointment of Messrs. Sessions, Ellsworth, Kilbourn, Sargent and Brewster.

On motion of Mr. W. C. Jewett, it was

Voted, That a committee of three be appointed to consider the game laws which expire by limitation at the next session of the Legislature, with power to make such recommendations to the Legislature as may seem desirable for the protection of the agriculture of the State.

The committee was constituted by the appointment of Messrs. Jewett, Richardson and Boise.

Dr. J. B. Lindsey, department of foods and feeding, Hatch Experiment Station, explained a proposed feed law; when, on motion of Mr. Barton, it was

Voted, That the Board endorse the proposed feed law, and that the action of the Board before the Legislature be left to the executive committee.

On motion of Secretary Stockwell, it was

Voted, That Dr. Peters, chief of the Cattle Bureau of the Board, be invited to address the Board on the condition of affairs in regard to the outbreak of the foot and mouth disease in this State.

Voted, That the report of the chief of the Cattle Bureau on the foot and mouth disease be accepted and his action endorsed.

FIFTIETH ANNIVERSARY MEETING

OF THE

BOARD OF AGRICULTURE,

AT

BOSTON.

JULY 22, 1902.

FIFTIETH ANNIVERSARY OF THE BOARD.

The fiftieth anniversary of the organization of the Massachusetts State Board of Agriculture was observed at Horticultural Hall, Boston, on Tuesday, July 22, 1902. Although the weather was not propitious, two hundred members and ex-members of the Board, with their wives and friends, were present, and partook of the pleasures of the occasion. Nearly all of the members of the Board of 1902 were present, and their names will be found in connection with the minutes of the special business meeting held before the opening of the anniversary exercises. Among the past members of the Board observed in the audience were Ex-Governor Boutwell and Messrs. Isaac Alger, G. M. Baker, N. B. Baker, S. B. Bird, J. H. Bourne, Ethan Brooks, Wm. P. Brooks, Geo. L. Clemence, George Cruickshanks, J. H. Demond, Chas. F. Fowler, Chas. A. Gleason, O. B. Hadwen, Walton Hall, C. L. Hartshorn, P. M. Harwood, H. A. Howard, J. E. Kimball, A. W. Lloyd, W. W. Rawson, L. S. Richards, F. H. Smith, Geo. P. Smith, W. M. Tucker, B. P. Ware, F. L. Whitmore and E. W. Wood.

The anniversary exercises began at 10.30 o'clock. Dinner was served at 1 o'clock, following which after-dinner remarks were made by Hon. J. J. Myers, speaker of the Massachusetts House of Representatives; State Senator C. B. Williams; Prof. J. W. Sanborn and Prof. F. W. Rane of New Hampshire; Capt. R. G. F. Candage, late president of the Farmers' National Congress; General Agent G. M. Whitaker of the State Dairy Bureau; Master of the State Grange Geo. S. Ladd; Jacob Manning of Reading; Elmer D. Howe of Marlborough; past members of the Board, B. P. Ware, Walton Hall, Geo. Cruickshanks, G. M. Baker, F. L. Whitmore and Prof. Wm. P. Brooks; also present members Brewster, Pratt, Kilbourn, Jewett, Hersey, Secre-

tary Stockwell and presiding officer First Vice-President Sessions.

Mr. John G. Avery moved a vote of thanks to the Massachusetts Horticultural Society for the use of its building for the anniversary exercises, which motion was seconded and carried unanimously. The gathering dissolved at 3.15 P.M. The proceedings of the anniversary exercises follow on subsequent pages.

ANNIVERSARY EXERCISES.

In opening the anniversary exercises, Ex-Secretary William R. Sessions of the State Board of Agriculture, who presided during the entire day, said: —

It is an auspicious occasion for those who are present, for most of us have been connected with the Board of Agriculture, first or last, some of us for many years, different men at different times. It is one of the highest honors of my life that I have been connected with it for so many years. It is twenty-three years since I became a member.

Massachusetts was one of the first States to provide for official connection between the State and agriculture, and to appropriate money to assist in the development of agriculture. She has been generous from that early day until now, and we have seen the liberality of the State government in what it has done for the agricultural societies, for the Agricultural College, for the farmers' institutes, and in various ways for the advancement and advantage of the agriculture of the State. But you did not come here to hear an address from me, — a man whom many of you have met repeatedly, almost daily, for years. You came to hear men who are known outside of our immediate circle. It seems to me suitable that you should hear first from the chairman of the committee of the Board of Agriculture, who made the arrangements for this meeting, — Gen. Francis H. Appleton of Peabody.

REMARKS OF GENERAL APPLETON.

General Appleton spoke in part as follows: Mr. President, it is as chairman of the committee of arrangements that I appear here, but I want to congratulate our secretary of the Board upon the success of this occasion, for it is he who has executed our plans for this day.

I cannot go as far back toward the early days of the Board as can some who are here, but I go back in memory to 1870, when, not as a member, but as a young agriculturist, I first came in touch with the secretary of those days, Hon. Charles L. Flint. It was my privilege to be acquainted with him, and to accompany him somewhat, which was a delightful experience. Not being myself, I regret, a linguist of many tongues, I can praise Mr. Flint for such helpful characteristics, which brought to him a knowledge of the reports of foreign experimenting in agricultural matters, and through him we obtained much helpful knowledge before our own stations had been developed.

It has been one of the agreeable experiences of my relations here, besides that we have all joined in trying to promote general agriculture, that I have had the acquaintance of so many people who have been connected with the Board in various ways.

We have together been participants in developing the interests of the Agricultural College and of the experiment stations; and, as director or trustees, in so trying to promote their best interests that a consolidation of the two agricultural stations has resulted under control of the trustees of the college. I think you will agree that, in order to promote the best in our agriculture, we must endeavor to see that the best results in scientific investigation and of scientific training are brought within reach of our agriculturists.

Science has made it possible to bring to our doors agricultural products in great variety and to sell them at a low price. The soil of Massachusetts must be fertilized and treated with and by brains as well as with manure and commercial fertilizer, in order to produce at a cost that will encourage the business of agriculture in its many forms.

The insect problem seems to be a most important one for scientific thought and care. Insect pests are many and of varied habits. It seems to have been proved that the strongest antagonist is he who has most interest in the result; and the owner is he who is best able to lead the attack. Does it not remain for the Board to see that the best ammu-

nition, in the form of knowledge of the strongest methods of attack, shall be within reach of the interested parties? This our Experiment Station and United States Department of Agriculture are endeavoring to do.

I feel strongly that a greater interest should be stirred up as to the importance of having the highest quality of milch cattle, swine and other live stock within reach of our farmers. It is too easy for the quality to lower unless there is incentive constantly advanced to show, by specimens, exhibits and results, a high standard in quality.

The Chair. The Commonwealth of Massachusetts has always fostered agriculture. It has always been active in its support and in appropriating money for its improvement. The governors of our State have usually been in sympathy with such action. I can say from my own knowledge that the present Lieutenant-Governor, when in the Legislature, was interested in all these matters. He gave them careful thought and consideration, and when he was speaker of the House, in the appointment of committees which had to deal with agriculture, he gave us suitable, sensible and able men. As the friend of agriculture, I now have the pleasure of introducing Lieutenant-Governor Bates, the representative of the Commonwealth.

ADDRESS OF LIEUTENANT-GOVERNOR BATES.

Mr. President and fellow citizens, I am here to-day mainly to bring the greetings of the Commonwealth of Massachusetts, at the request of the Governor, who is not permitted to be present himself, and his interest in the Board is well known. He sends you his heartiest greetings for the success of the management of this occasion.

I have been thinking of one thing which I wish to bring to your attention, and that is, the debt which the people of Massachusetts owe to their rocks and sands. Yesterday I was with the people of Swampscott, trying to help them celebrate the fiftieth anniversary of their municipal existence. There I discovered that it was not only the fifty years of their municipal existence of which they were proud,

but also of the fact that the settlement reached away back to the beginnings of the Puritan Commonwealth, two hundred and seventy-three years, and had been a typical settlement of many in Massachusetts from that day to this. And I found that, although at the present day most of the territory is occupied by those who have come there attracted by the charms which nature has bestowed upon the town, and those who have come there that they may have a beautiful place where they may spend their summers, nevertheless, the residents are more proud of the fact that Swampscott owed its fame to its early history as a fishing settlement. The fishing industries of Massachusetts were perhaps her first great industries. But we owe the fishing industries of Massachusetts largely to the fact that Massachusetts was composed of rock and sand. There were no mines, no precious metals. There was not an opportunity for bountiful crops, and the people, in order to obtain a living, were driven into the sea. As a result of their struggles with the great deep, they developed the character which made the foundation of the enterprising, industrious and courageous people of Massachusetts to-day. They dragged out their livelihood from the sea. They did more, — they brought wealth out of the sea, with all the comforts which wealth can bring.

I recently had my attention called to a bulletin issued by the United States government, — a census bulletin of the manufactures of Massachusetts. Any one who had stood on these shores two hundred years ago would never have thought that this small territory could become prominent in the world as a manufacturing centre. There were no raw materials here. There were no gold mines in which they could invest or from which raw materials could be developed. There were the rocks and sands. But in order to develop the State in respect to its natural resources, it was rendered necessary for the people to become industrious, enterprising, courageous; and, because of that necessity, in the course of generations they have developed in such a way, as we have seen, that the resources of the State have brought them wealth and prosperity.

Unfortunately, perhaps some of those present may think, the sheep industry of the State is still small, and has been diminishing in recent years. As to the figures, I haven't them at present, but certain it is that the sheep industry of the State is not a large industry. We don't raise much wool. And yet Massachusetts mills lead in the manufacture of wool products. She manufactures one-fourth of all the woollen goods manufactured in the country. She manufactures one-third of all the worsted goods manufactured in America. Our forests, our spruce forests on the hills, largely disappeared many years ago; but the spruce forests of Maine and Canada are being hauled up to our mills, and we are producing one-fifth of all the products of the paper mills in the country. We lead the list in the manufacture of fine papers. We do not grow, and so far as I know, we never have grown, a pound of cotton within our territory, we are many hundreds of miles from the cotton fields: and yet the people of Massachusetts have 41 per cent of the spindles and 39.8 per cent of the looms that are engaged in the cotton manufacture in this country, bringing our raw material into the State. We easily stand far ahead in cotton manufacture. We manufacture over one-third of all the cotton goods manufactured in the country. We have no broad prairies upon which to feed herds of cattle, and yet the meat products manufactured in Massachusetts go all over the world.

I sat last night beside a gentleman who is engaged in the tanning business. He told me that he had a tannery in Pennsylvania and one in Massachusetts. The company were increasing their business in Massachusetts and diminishing in Pennsylvania, although a few years ago they thought, because the raw material was down there, the tanneries would gradually go there. But he thought that the conditions for manufacture were better in this State, as a matter of fact; and we have the largest tanneries, and the tanneries having the largest output of any tanneries in the world to-day are in this State.

Although no herds of cattle are actually raised in Massachusetts, yet this State not only leads in the manufacture

of boots and shoes, but she produces as many different sorts and sizes as can anywhere be found in that industry. She also is first in the manufacture of rubber shoes and of all kinds of rubber goods.

I have said that she has no mines or precious metals, but the genius of her people, their manufactures and enterprise, has made her an important factor in every financial centre of the globe. The entire product of the manufactures of Massachusetts in the year 1900 amounted to $1,035,000,000 worth; and nearly all of the goods manufactured came from hundreds of miles beyond her borders, and she brought the goods here as raw material. There was necessity for exertion for this success, because of the fact that the people realized that where nature had not been lavish it was imperative for the people to be more energetic and more enterprising. Rocks and sands are a prominent feature of Massachusetts, and yet to-day we are celebrating the fiftieth anniversary of her Board of Agriculture. That, as your chairman has said, was one of the first boards of agriculture established in the United States. It is not for me here to dwell upon the details of these matters, but the bulletin issued by the United States government on the agriculture of Massachusetts reveals some of the reasons for congratulation to-day upon that industry. We have been so accustomed to the large statistics of the manufactures to which I have already referred that we hardly realize how many are actually engaged in the farming business which is now under consideration, and how great is the sum of its products. But, as I gather from a recent bulletin of the United States, the products of the farms of Massachusetts amounted to more than $42,000,000 in value, or about $15 in value for every man, woman and child in the State. It is an industry which affects every home. It is one that perhaps is more closely connected with the material welfare of the people than is any other. It is also gratifying to learn from the same census bulletin that the popular idea that the farms of Massachusetts are diminishing and that they are becoming the property of summer residents for use for vacation purposes is also not well founded on fact; for I find from

that same bulletin that there has been an increase, — not only that in the number of farms there has been an increase, but a remarkable increase in value during the past ten years. There has been an increase in number, an increase in value and an increase of over 50 per cent in the value of the farm products in the last decade.

Such results as these are results of which your Board of Agriculture has a right to be proud to-day. There is a reason in them for its existence. The increase in the values of farm products is remarkable. We go west and buy land, in order that we may obtain the increase from the speculative value and growth of the country. But the farms in the vicinity of Boston, the farms in Suffolk County, have increased over 300 per cent in value in the last decade, and the farms in every county in the State, with the exception of two, have increased very largely in value during the same period.

The Massachusetts State Board of Agriculture has assisted in fostering this industry. It was established because the character of the soil rendered it necessary that some protection should be given by the State, and she has offered it as far as it was feasible. The aid thus given has been rewarded. The experience of the Board of Agriculture has been a great advantage to the farmers of the State. The members of the Board have brought to the farmers the results of their broad experience. The results have surpassed anticipations. This protection to the farmers and the results in our agriculture justify the legislation which has been given for their benefit. All over the State does the result of this benefit appear in the improved condition of the farmers. But there is something more valuable for them to develop than herds of horses and cattle and swine and sheep. It is more important for them to develop character than the number and quality of the vegetables, fruits and cereal products of their farms. This they have done; and such, in brief, is the result of the legislation of recent years, and why it is a pleasure, in representing the Commonwealth to stand here to-day and express to the Board the greeting of the Commonwealth which has helped to accomplish these results. I bring congratulations

to the Board and to the farming element of the community that occupies 60 per cent of the territory of the State. Their record is to the honor of the population of Massachusetts, and the honor of those who have accomplished thus splendidly the conquest of the soil.

The Chair. Fifty years ago to-day this Board was organized. The man who was its first president gave yeoman's help in its organization. He was the honored Governor of Massachusetts, the executor of its laws; but he was anxious to do his whole duty in helping the people of the Commonwealth to advance and prosper. He saw an opportunity to assist them in the development of agriculture. He took a leading part in the establishment of this Board. By the law made a member of the Board, he gave of his time and talents to the duties of the position, attended the meetings of the Board, served on its committees, acted as delegate to fairs of the agricultural societies, and as such delegate made report to the Board of the fairs he attended. His counsel was of great value, and was highly appreciated at the time and is gratefully remembered by all who have since served on the Board and by the farmers of the State. His devotion to duty was seen and appreciated by the State and nation, and in the trying times of civil war and reconstruction he was called to serve as Representative and Senator in Congress and as Secretary of the treasury. History will make sure that his services shall be always remembered. He still lives to see the fruit of his labors. I am greatly honored by the privilege of presenting to you the Hon. Geo. S. Boutwell of Groton.

ADDRESS OF EX-GOV. GEORGE S. BOUTWELL.

Mr. President and ladies and gentlemen, I find that in the opening of the meeting an error was made in the management which ought to be corrected. It is now too late to correct that error, but personally I should like to disabuse your minds of the thought that I am to deliver an address. Lieutenant-Governor Bates has done that to the satisfaction

of us all. The fact that by virtue of the office which I held I was also the first president of the Board of Agriculture is an agreeable retrospect of my life, and I am glad to be here to-day. If there is any other person present who was present on that occasion, I should be glad to see him.

In these fifty years great changes have been made in the processes of agriculture in Massachusetts. I think that fifty years ago the mowing machine had no place as an instrument of industry. It could not have been more than an experimental machine then. Many features have been added since that time. I cannot give the precise date when the mowing machine came into general use. I am not sure when I saw the first mowing machine, but it was not until the '50's. I had a foreman on my place, but he did not take a liking to the mowing machine. He came to the conclusion that he could not run it, and that with two good mowers he could do as much work as a mowing machine. But he had a boy who was about fifteen years old. I told him that if he would get up on the machine and run it I would add to his wages fifty cents a day. He got up on the machine and ran it so well that his father, after two days, had to take back what he said about the machine. Such were the prejudices of the farmers. They are not inclined to engage in any new business, though they take up an invention when its merits have been established. There was another invention which came in the early '30's, perhaps it was in the early '20's, — that of the cast-iron plow. It was a wonder in the neighborhood, and the occasion of a great many prophecies of failure. But those prophecies which were made have all failed.

There have been a great many changes in the methods of agriculture. Some statistics show that we have advanced, but some other statistics may show that we have retrograded. But the farmers have gained very much. People have gained in some lines of employment, and in others they have not. But the farmers have been able to make a success in life, and they have accumulated property. I remember the time when a man who was worth a million dollars was a very rich man. There was one man of wealth who was

everywhere well known by reputation, — Abbott Lawrence. He died in 1854, I think. He was accounted in Boston, in New England and in the country as a rich man. I think he was worth $1,750,000. In comparison with the enormous fortunes of the present day, that was not much. I don't know what is to be in the future. I am not going to prophesy about these great accumulations of wealth. I suppose that they will disappear gradually if we can keep them within the system of the laws of family distribution of property. That is a matter that may very well be considered, — whether people shall be permitted to transfer property in vast sums outside of the persons that they have to provide for, by the laws of descent and distribution.

About everybody has advanced in wealth and comfort. If you go into a railroad station and a car passes you, going in the same direction that you are going, at a more rapid rate, your sensations give you the idea that you are retrograding or going back; while, as a matter of fact, you are going forward, but at a different rate of speed. That is the fact in our life to-day. Mechanics and laborers are all better off than they were fifty years ago. They are much better off than we might imagine if we did not consider what was their condition many years ago. Then $8 or $10 a month was paid to a farm laborer in the summer. One dollar a day was paid for a man for mowing, if he was a good mower. Girls in families got $1 a week and their board. Everybody has gained.

It is so with the farmers. There is a view of agriculture that occurs to me in view of these changes. In Massachusetts, certainly, and in New England I have no doubt the same facts prevail, though it may not be so in parts of the west, — but here it is practically impossible for a man of wealth to buy a large tract of land and farm it by hiring men, and get more than one per cent on his investment. Many things combine to make it so. That condition acts as a breakwater, always standing up against a policy whereby rich men might buy land and farm it. Unless the owner is a worker upon the land, to make it productive and to economize, the farm cannot be managed profitably. The farmers

must live on their land and work it themselves. This is the fact, although it may seem a hardship that a man cannot stand round and hire somebody to do his work for him and he live on the proceeds. But this is a preventive measure against the monopolization of the land by these rich people who are accumulating vast sums of money. Very few of those engaged in agriculture are successful who are not living upon the land and connected with it as owners. Their personal success is at stake all over the country in the success of their farms. These men are a valuable part of our population, and no class deserves more distinction. They live upon the land, they are independent, they are taking part in public affairs, deciding what shall be the policy of the municipality in which they live, doing something which contributes to the good of the public, and helping to decide what the policy of our great country shall be. A large body of such men cannot be located in the State without exerting an important influence upon its history. Whatever may be said by the politicians, there will come a time, every now and then, when the people will stand up in their might for the purpose of saying what ought to be done. When everything goes right, then the people do not feel that it is necessary for them to pay so much attention to the government. But let there be a war, with the consequent demand by force for the lives of young men, and the entire administration that has overstepped the bounds of right will go to the wall. So, when the people are really concerned they will do something, and in the main they will do what is right. They take time to consider. They don't decide to-day what ought to be done to-morrow in public matters; but give them a succession of to-morrows, and they will decide what the policy of the country shall be.

It is a fortunate thing that farming is of such a character that it will not enable a rich man to engage in it with success, as a rule, unless he goes to work with his hands on the farm. Otherwise he must spend money for the gratification of seeing something grow, or something exist which would not have existed otherwise. There is such a thing, no

doubt, as having too much of this world's goods, so that the owner does not know what to do with it. That is said, though I know nothing about it myself. Such cases are perhaps one in a hundred. But it requires large ability to invest in land and make it profitable. But great success can be attained by those who work their farms themselves and give it the attention it deserves. The present tendency of the farming classes is towards an improved condition. At any rate, it is very largely so.

We are here in a Commonwealth that has had a very great history. What we produce in Massachusetts is not half as much by agriculture as we could get in Illinois or Iowa with their capacity for production. We are not great in the quantity of our products, but we are high in the quality of our crops. But there is something better than crops which we produce in Massachusetts. The first thing to be obtained for a State is to have men. If you will raise men in a community, then the people will grow, and show something that is worth having. They will do something which is worthy of talking about. They will create something which will produce some effect upon mankind. They will be of worth in the world.

We have made some good inventions in Massachusetts. We have not been fortunate enough to invent the wireless telegraph, but we did something about the telephone system, first and last. There is the sewing machine, — we are entitled to that, — and many other important inventions. The farming industry must keep pace with those inventions relating to agriculture which are important. The Agricultural College, which is a part of the State's system of agriculture, ought to find out what is best for the farmers, and it has already shown what the college is good for thus far. That is what it has been doing, I think, with the little knowledge that I have of it. It finds out what is good, and commends it to those who will accept it. When the Board of Agriculture was created, I had some notion about what should be done, especially by an agricultural college. That is one of the many cases where something I said did not produce any good effect, though I presume it did not pro-

duce any bad effect. My idea was, that out of the Agricultural College and the Board of Agriculture there might be produced a system by which the State should have the benefit of annual teachings in different localities and municipalities by the professors, and that those who were educated upon the scientific side of agriculture would speak, and that thus every agricultural town in the State would be visited by such a person, and such lectures would be given as might be adapted to the situation. I don't know how far that idea has ever obtained a position in the minds of the people, or how far it has been practised by professors of the college. I still think that there is something in it, therefore I venture to refer to it. Possibly some person may consider it and carry it forward. The first thing necessary in attempting to carry out any effort systematically is to get hold of the idea which underlies the scheme. You may believe that a machine is useful, yet in order to succeed with it you must understand the idea of the man who made it; you must be able to grasp his idea in order to use it successfully. You may believe that a thing is unsound, but you want to be able to point out the unsoundness, in order to be sure of your ground. Therefore, the intellectual part of what the farmers employ in agriculture should be constantly educated and stimulated, so that they may not only observe and profit by what their neighbors do, but find out in each case the reason for what he is doing. The reason may be a good one, or it may not. A man may do something just right, without making mistakes, but he is not sure unless he understands the reason for what he does. In the end, you want to find out what is wise in any particular branch of business, and then pursue it. If somebody discovers a better way of doing things than your way, then accept that.

I believe in progress. I believe that things may be better here if they are worked out according to some controlling idea; and that we ought not to abandon agriculture in Massachusetts because we can make a little more money in the west than we can here. Consider whether, on the whole, your situation is not as desirable as that of other

people; whether you are not getting on in the world as well as other people, upon a fair average. One man may be in one position, and another man in another position which seems not to be as good. But consider whether, on the whole, there are not as many men below you as there are above you, — men who are doing no better than you are. You may find that you are in a very satisfactory position, compared with most people.

The Chair. Massachusetts, as Lieutenant-Governor Bates has said, has been and is now an important part of the country, and, in the view of the farmers of Massachusetts, its agriculture is of high importance. While the area of the State is small and the agricultural proportion of her people still smaller, yet, if you will compare its agriculture with that of States of greater area and population, you will find that Massachusetts produces a greater value of agricultural products in proportion than some of the larger States. The United States government has taken up the task of helping agriculture, of fostering it, of helping to bear its burdens and of extending its opportunities, all for the benefit of the agricultural classes. It has a Department of Agriculture, represented in the cabinet by a secretary. We were unable to procure the attendance of Secretary Wilson here to-day, though I am sure he would have enjoyed this meeting; but he sends one of his foremost workers to bring the greetings of the United States Department of Agriculture, and speak to us of the agricultural progress of the country. I introduce to you Mr. Frank H. Hitchcock of the United States Department of Agriculture.

SOME FEATURES OF THE WORK PERFORMED BY THE UNITED STATES DEPARTMENT OF AGRICULTURE.

By Frank H. Hitchcock, Chief of the Division of Foreign Markets, Department of Agriculture.

Mr. Chairman, in making the arrangements for this semi-centennial meeting of the Board, your officers invited the Secretary of Agriculture to be one of the speakers. It was

with great regret that the secretary, owing to previous engagements in the west, was unable to accept your cordial invitation. Knowing the high standing of your organization and the important work it has accomplished for agriculture during these many years, he was especially reluctant to miss an occasion of this nature. I regret exceedingly, on your account, that the secretary is unable to be here, for he could have described to you much more forcibly and entertainingly than I the important work that is being so successfully carried on under his masterful direction. I shall not attempt to cover the department's operations as a whole, for that would require too much time. I shall merely touch upon special phases of the work, directing your attention more particularly to what is being done in the way of introducing into the United States certain products of foreign agriculture not found here originally, but nevertheless capable of being grown to advantage in some portion of this vast country, varied as it is in soil and in climate. The diversification of American agriculture by the introduction of such products from abroad is to my mind one of the most valuable and interesting features of the present policy of the department.

Egyptian Cotton.

In the mills of New England large quantities of Egyptian cotton are used each year in the manufacture of certain of the finer grades of cotton goods, such as hosiery and knit fabrics. We annually expend from $6,000,000 to $7,000,000 in the importation of this cotton. It has an exceedingly fine, silky fibre, answering purposes not met by our American cotton, either upland or sea-island. For several years experiments have been conducted under the supervision of the department to ascertain if Egyptian cotton could not be grown in the United States, and the large sum that has to be paid for importations saved to our people. Careful trials have been made to this end with selected varieties procured from Egypt, and after repeated breedings such success has been obtained as to warrant the belief that Egyptian cotton can be produced here on a commercial scale. During the

past year experimental patches were cultivated in five of the southern States. A bale of Egyptian cotton raised on one of these patches in southern Georgia was sent to a Connecticut mill, and there thoroughly tested as to spinning qualities, the verdict being that it was quite equal to the imported article. Those who are familiar with the subject no longer doubt the possibility of growing enough Egyptian cotton on American soil to meet the requirements of our mills.

Sumatra Tobacco.

One of the most interesting agricultural experiments conducted under the supervision of the department last year was the growing of Sumatra tobacco in the Connecticut valley. On selected soils at places distributed along the valley in Connecticut and southern Massachusetts, amounting in all to over 40 acres, quite a crop of this peculiar type of tobacco was raised. The plants were grown under shade, the areas cultivated being covered with tent cloth. The experiment resulted most successfully. In the opinion of experts, the tobacco produced was fully equal to the best imported Sumatra. Owing to the success of last year's trial, which showed conclusively that the Sumatra leaf could be grown commercially in the Connecticut valley, plans were made looking to a further extension of the industry during the present season. As a wrapper for cigars, no other tobacco has been found to take the place of Sumatra; and we have been obliged to import annually from $4,000,000 to $5,000,000 worth for that purpose. In view of the success attending the experiments in the Connecticut valley, there is a likelihood that a large part, if not all, of the money expended in importation will in the future go to American producers.

Macaroni Wheat.

A considerable sum of money is spent each year in the importation of macaroni. This product is manufactured from a special kind of wheat grown largely in southern Russia and in Algeria. A study of the macaroni wheats in those countries led to the belief that they could be grown to advantage in certain parts of the United States and

especially in some portions of the west, where other kinds of wheat cannot be successfully raised, owing to the lack of sufficient moisture. Selected varieties of macaroni wheat were accordingly procured in Russia and Algeria by experts of the department sent there for the purpose, and these imported wheats were given a trial in several of our western States, where they were found to thrive under conditions unfavorable to our native grain. The farmers of those regions have been quick to see the advantage of planting macaroni wheats, and the demand for seed has been large. During the past year the department imported and distributed 20,000 bushels. This kind of wheat is now being grown quite extensively in such States as North and South Dakota, Kansas, Nebraska and Texas. In the dry regions, where the macaroni wheats thrive, they are said to yield from 25 to 50 per cent more than other varieties. The increased production attained by the substitution of the imported seed for native wheat has already more than repaid in value the amount the department has expended in the experiment. There is every reason to believe that before many years macaroni wheats will be grown here in sufficient quantities not only to supply domestic wants, but to provide a surplus for exportation.

Rice.

To the Department of Agriculture should undoubtedly be given a large part of the credit for the rapid development that has recently occurred in the rice industry of the United States. Several years ago it became apparent that the rice produced in the south was not altogether the best kind for milling purposes. It was finally decided that the Kiushui rice of Japan would probably give the best results, and the department proceeded to secure quantities of that variety for trial in Louisiana and Texas. The outcome has been highly successful. The production has increased with such strides during the last few years as to lead to the expectation that this country will in the near future be an exporter rather than an importer of this cereal.

Tea.

Last year 4,500 pounds of tea were produced at Summerville, S. C. The experiments in tea growing conducted there during the past few years have given surprising results, leaving no question as to the possibility of producing high-grade tea in the United States. The tea picked last season, according to the testimony of experts, was equal in flavor and aroma to the imported article. It found a ready sale in the markets of the north, and brought a remunerative price. The experiments made at Summerville show that, under the conditions prevailing there, tea can be grown at a profit of from $30 to $40 per acre. The labor problem in this enterprise has been satisfactorily solved by the employment of colored children who would otherwise remain idle. As there are extensive regions in the south where equally favorable conditions exist, there seems to be no reason why the industry should not be largely extended. The plan of growing the tea under shade has given satisfactory results, as has also the employment of irrigation in tea culture. On the whole, great encouragement is felt as regards the success of the project to grow tea commercially in the United States.

Dates.

Some years ago it occurred to one of our scientists, who had been studying conditions in the south-west, and especially in certain portions of Arizona and southern California, that the African date palm might be made to thrive there, in regions where the summers are so long and hot and the climate so exceedingly dry that little else of commercial value can be grown. Several specimens of this palm were accordingly procured from Egypt, in order to make the trial. Owing to the success attending this first attempt, larger importations have since been made by the department, partly from Egypt and partly from Algeria, and now many examples of the date palm can be seen growing vigorously in the south-west. It will flourish where the soil is so largely alkaline that hardly any crops can be produced, all that is needed for the palm being irrigation. The suc-

cessful introduction of the date palm will add greatly to the agricultural value of the regions where it is made to grow. We are encouraged to believe that before long the south-west will furnish dates in sufficient quantities to make importation unnecessary.

Figs.

The production of figs is another enterprise that has been given a start in the United States through the assistance of the department. Although numbers of Smyrna fig trees have been growing in California, they were until recently of little commercial value, owing to the absence of the peculiar insect that in the Mediterranean countries completes the fertilization of the fig, and thereby renders it an article of commerce. Several years ago the department's entomologists procured from Algeria wild figs containing this insect, and sent them to California. In due course the insects issued from the fruit and proceeded to fertilize many of the Smyrna figs growing in the neighborhood. The insects were successfully propagated, and, having now been carried safely through two winters, can be regarded as practically established in that region. Since the introduction of this necessary fertilizing agency Smyrna figs have been produced in increasing quantities, until the industry has assumed such proportions in California as to suggest great possibilities for the future. It is reported that last year a crop of from 50 to 75 tons was gathered, and careful tests of these figs seemed to show that they are in no wise inferior to imported fruit.

San José Scale.

In this connection, as an additional feature of the valuable work performed by our entomologists, reference can be made to the discovery of what appears to be an effective natural enemy of the San José scale. In view of the great losses this pest has entailed upon the fruit industry of the United States, and especially some of our eastern States, the importance of the discovery is apparent.

From the time the San José scale first appeared in our orchards there has been a controversy as regards its probable

origin. During the last few years the prevailing opinion has been that it came from Japan. Since its arrival in the United States vain search has been made here for a predatory or parasitic enemy to hold it in check. Our scientists adhered to the belief, however, that such a natural enemy could be found in the original home of the scale; and, the indications seeming to point to Japan as the place of origin, the department decided to make a thorough investigation there, with the hope of finding the desired predatory insect. One of our entomologists was accordingly sent to Japan last year to make the quest. During an investigation of several months he was surprised to discover that wherever the scale was found in Japan it appeared on imported stock, indicating that it could not have originated there. On the contrary, the conclusion was reached that the scale, instead of coming from Japan to the United States, as originally supposed, made its way to the island empire on fruit imported from America. Convinced that the scale was not indigenous to Japan, the department's expert proceeded to China, going first to Chefoo. About Chefoo he discovered the scale in considerable abundance; but, as imported fruits were growing there as well as native stock, it was impossible to tell whether or not the scale was indigenous. Proceeding to Pekin, however, he found a condition that was conclusive. In that neighborhood, where exclusively native fruits were growing, the scale was still present. From Pekin to Tientsin, and beyond towards the great wall, it occurred quite generally, but in limited numbers, on native fruit trees. Throughout this region it was held in check by an efficient natural enemy in the form of a ladybird beetle. Live specimens of this valuable beetle were gathered in considerable numbers to be brought to Washington. Strangely enough, all of these beetles died en route except a single pair. Soon after the pair's arrival at the department a brood of about fifty made its appearance. These American-born specimens reproduced in turn, until quite an extensive stock of the insects is now thriving in our insectorium, where they feed voraciously on the scale. The stock will soon be large enough to permit the distribution

of the beetle to districts infested by the San José scale, and interesting results are expected from its introduction. The importation of this beetle and its successful propagation here undoubtedly constitute one of the most important features of the work accomplished by the department during the past year.

Other Lines of Work.

The operations I have described represent only a few of the many lines of work carried on by the Department of Agriculture. During the last four or five years the department's work has been greatly broadened in scope, until now it touches practically every subject that has a bearing upon the agricultural interests of the country.

Valuable assistance in this work is received from the various experiment stations scattered throughout the several States. The relationship of these stations to the department is now one of active co-operation, under the general supervision of directing officials at Washington.

With the more general duties of the department you are doubtless familiar. The weather, not only in its direct relations to agriculture, but also as affecting the safety of life and of commerce on lake and sea, continues to furnish one of the principal fields for study.

The soil, which is the foundation of agriculture, has become the subject of more active investigation than hitherto. Special attention is given to the question of soil improvement, including means of irrigation where the rain supply is insufficient. The soils of the United States are being examined on an extensive scale, and carefully tested in order to determine their adaptability to various crops.

In this work the chemical experts of the department render valuable assistance, at the same time devoting attention, as formerly, to such important subjects of inquiry as the nutritive value of agricultural products and the question of food adulteration. Our chemists are also performing a useful work in the study of materials with which to improve our public roads, — another matter in which the department is actively interested.

The task of impressing upon our farming communities the desirability of good roads over which to market their produce is being performed with exceptional energy. Under the supervision of the department's experts, sample roadways are being built in many of the States, and the farmers thus shown in an effective manner scientific methods of road construction. The saving in the cost of transportation that results from the substitution of properly constructed roads for the miserable thoroughfares found in too many portions of the country can hardly be overestimated.

One of the important lines of work in which unusual activity has been displayed during the past year is forestry. The intimate relationship of forestry and agriculture is coming to be more generally recognized, and the vigorous measures the department is taking to conserve our forests seem to meet with universal approval.

Efforts have recently been made to improve the crop-reporting service of the department. Timely information as to the state of the crops is of unquestioned value to the farmer, affording him knowledge on which to base the sale of his produce.

The valuable work the department has long been carrying on in reference to our animal industry, and especially in the prevention of contagious diseases affecting live stock, is so well known as hardly to warrant mention. The measures taken to insure the safety and health of animals during shipment across the sea have accomplished much in the way of promoting this branch of our export trade. It is a significant fact that the insurance rate on cattle sent to Europe, which was formerly as high as 8 per cent, has fallen, under the methods enforced by the department, as low as ½ of 1 per cent. In this item alone the department's supervision of the trade saves our live stock exporters each year several millions of dollars, or more than enough to pay the expenses of the entire system.

Additional measures are employed by the department to foster and develop our export trade in products of the farm. The study of foreign markets and of opportunities for their extension has not been neglected. Trade openings of special

promise have been taken advantage of in a practical way by making experimental shipments. High-grade dairy products, carefully labelled to show their United States origin, have been forwarded by the department to distant markets in several quarters of the globe, and there placed on sale, in order that foreign buyers may learn to know the superior quality of American produce. Similar steps have been taken as regards some of our native fruits and vegetables.

It may be added that the supervision hitherto exercised by the department over the exportation of live stock and meat products has this year been extended so as to include dairy products, and thus the integrity of our agricultural export trade is still further guaranteed.

Under the resourceful and progressive leadership of our present secretary, the Department of Agriculture has unquestionably become a far more active agency than hitherto in advancing the interests of the American farmer.

In the great work with which the national department is charged it receives invaluable assistance from the various State organizations, among which there is none of higher standing than the Massachusetts Board of Agriculture. If Secretary Wilson were here to-day he would extend to you his most hearty congratulations on this anniversary, marking, as it does, a period of great usefulness. In his absence it becomes my privilege and my pleasure to offer these congratulations, which I do most heartily.

The Chair. Massachusetts has an agricultural college, and this Board of Agriculture has been connected more or less closely with its administration. This is in accord with the State law. The Board has the duty of fostering and supervising the college. The college has a faculty who, to a large extent, come in contact with the farmers of our community, as Governor Boutwell suggested, with scientific lectures and certain knowledge upon the various educational topics of the times, upon which scientific men are able to give instruction to the people. From the very first there has been connected with that college the man who is now its president. He was not a born farmer, but he was inter-

ested in agriculture from the first; and, if he is not skilled in agriculture himself, he has the ability to pick out for professors those who are skilled and are able to do good work for agriculture. President Goodell has been eminently successful in selecting his professors and experimenters to deal with the scientific facts connected with agriculture. He has administered the college and the experiment station with eminent success. We all know him, and we are glad to meet him, as we do each year; and he will now tell you what influence this Board has had upon agricultural education.

ADDRESS OF HENRY H. GOODELL, LL.D.

President of the Massachusetts Agricultural College.

Many centuries ago the Apostle Peter, writing to his followers, said, "I stir up your pure minds by way of remembrance:" and centuries before the Apostle Peter lived it had been written, "Remember the days of old; ask thy father and he will show thee; thy elders and they will tell thee." It is fitting, therefore, that at the close of this first half-century of its existence the Board of Agriculture should hold its day of remembrance, and, calling upon its father to show them and its elders to tell them, gather up the memories of the past and transmit them to their children to hold and guard forever. My mission, then, to-day is to stir up your pure minds by recalling to your remembrance the relation of this Board to agricultural education, and more particularly to its college of agriculture. Thirty-nine years, counting from the charter of this college, is the measure of its span, and each year has brought with it some expression of the Board's thoughtful care. Even before its establishment as a Board we find the trustees of the Norfolk Agricultural Society voting that its "president and secretaries be a committee to mature and adopt a plan for a convention of delegates from the various agricultural societies of the Commonwealth, to be holden at some convenient time and place, the object of which shall be to concert measures for their mutual advantage, and for the promotion of the cause of agricultural education." At the morning

session of that convention, held at the State House, March 20, 1851, the president, Marshall P. Wilder, announcing the subjects for discussion, spoke as follows: "It is also to be hoped that the cause of agricultural education, now about to receive the consideration of the Legislature, will not be overlooked in the deliberations of this body; and, if it be the opinion of this convention that agriculture may be promoted by the application of science, that such a sentiment may be expressed in terms so explicit as not to be misunderstood, and that the aid of government may be solicited for this purpose." In the afternoon session Mr. Sewall of Medfield, from the business committee, presented a preamble and resolutions, the fourth, fifth and eighth of which bear directly upon the subject now under consideration: —

Resolved (4), That agricultural schools having been found, by the experience of other nations, efficient means in promoting the cause of agricultural education, which is so essential to the prosperity of farmers and to the welfare of communities, it becomes at once the duty and policy of the Commonwealth to establish and maintain such institutions for the benefit of all its inhabitants.

Resolved (5), That the several plans for an agricultural school, recently reported by the Board of Commissioners appointed for that purpose, are worthy the profound consideration of the people of Massachusetts and their representatives in the General Court, as indicating the feasibility and practicability of an establishment worthy that exalted character which the State has secured by the endowment of kindred institutions, designed, like these, for the diffusion of useful knowledge among the people.

Resolved (8), That the convention respectfully suggests to the Legislature the propriety and expediency of reserving the entire proceeds of the sales of the public lands of the Commonwealth — from and after the period when the common school fund shall have reached the maximum fixed by the act of 1834 — for purposes of education and charity, with a view to extending that aid and encouragement to a system of agricultural education, which the importance of the subject so imperiously demands.

The discussion over the different resolutions was, as the faithful chronicler puts it, continued, protracted, and at times vigorous. It was carried over into the evening session, and among those taking part we find the names of

Marshall P. Wilder, Governor Boutwell, President Hitchcock of Amherst College, Professor Fowler of the same institution, Judge Mack of Salem and William Buckminster, editor of the "Massachusetts Ploughman." John Brooks of Princeton appears to have been the only opponent. He said: "This resolution seems to squint towards a college. If it has that tendency I shall be opposed to it, for I do not believe that the farmers are prepared to spend money in instituting a college. . . . As for lecturing to the people, I doubt whether that is advantageous, for the very best reason to my mind in the world, — that the lecturer will not know what to say: that he has no data on which to make out any speech, because science, as I understand it, is based upon facts. What facts has this commissioner that are applicable to agriculture in this State? I say, sir, generally speaking, no fact. And why? Because the science of agriculture has not yet grown up in this country." Richard Bagg, Jr., of Springfield closed some breezy remarks by exclaiming: "Let us remember that if the State provide the means and appliances for a scientific course of agricultural study, the young man must 'wake up from his drowsy nap,' and qualify himself 'to go up higher.'" The fourth and fifth resolutions were adopted, but we fail to find out the fate of the eighth, having reference to reserving the entire proceeds of the sale of public lands for purposes of education and charity.

At the first meeting of the Massachusetts Board of Agriculture, Sept. 3, 1851, Marshall P. Wilder, Wm. C. Fowler, John W. Proctor, J. H. W. Page and S. Reed were chosen a committee to report on the subject of agricultural education and the best measures to be adopted for the encouragement of such education. The report of this committee was presented at the second meeting of the Board on Jan. 14, 1852. They were discussed at this meeting, and also at the third meeting of the Board, on Feb. 3, 1852, when they were adopted. This report, signed by Marshall P. Wilder as chairman, resolves, "That Massachusetts, by an enlightened policy and wise legislation, has rendered her system of education worthy of her exalted reputation, and that this

Board most earnestly desire her to complete that system by providing kindred institutions for the scientific education of the farmer, upon whom is levied so large a share of the taxes for the support of governmental and philanthropic objects; that it is the duty, as well as the interest of the State, to aid in furnishing the means for such an education; and that a thorough, systematic course of education is as necessary to prepare the cultivator of the soil for preeminence in his calling, as to secure excellence in any of the schools of science or art." These are no uncertain words, and fittingly echo the fervent hope of Mr. Wilder in his opening remarks, "that, if it be the opinion of this convention that agriculture may be promoted by the application of science, such a sentiment may be expressed in terms so explicit as not to be misunderstood."

There seems to have been at this time a general awakening to the necessities of an agricultural education. Henry L. Dawes, in an address on agricultural education before the Housatonic Agricultural Society in 1853, after enumerating the obstacles to be encountered by the farmer in the discharge of the grand, crowning duty of the day, — the regeneration of the soil of Massachusetts, — said: "And the means not now within his reach, that shall enable him to triumph over them in this great attainment, are the necessities of the farmers of this Commonwealth. The means lie in an agricultural education. And for their accomplishment let Massachusetts establish an agricultural school, where will be taught the principles of the science and their application to the art of agriculture; and let the doors of knowledge be opened wide to all the sons of her soil, — not for the study of the speculative and mysterious, but the practical and useful."

The Board of Agriculture led the way in this popular movement; and we find that at its third meeting, held Sept. 7, 1852, a committee was appointed to consider the expediency of preparing a manual on agriculture for the use of common schools.

Again, at a meeting held three years later, Jan. 16, 1856, a committee previously appointed to consider and report to

the Board what further measures, if any, were needed to subserve the cause of agriculture in this Commonwealth, made the following report, which was accepted: —

Having given the subject their careful consideration, the committee are of the opinion that nothing would be better calculated to advance the cause of agriculture and foster and direct the growing interest therein throughout the community at large than the immediate establishment of an experimental farm, and, as soon as the funds shall permit, of an agricultural school in connection therewith, where both the science and the practice of farming may be taught in all their departments.

Your committee do not propose to set forth in detail the many reasons which have led them to this conclusion. but they will be pardoned in suggesting one or two of the most important: —

First. — There is not at the present time, to the knowledge of your committee, any society or Board existing in the Commonwealth authorized by act of the Legislature to hold funds to be applied exclusively to the advancement of scientific and practical agriculture or the diffusion of knowledge connected with rural economy.

Secondly. — In the opinion of your committee, the time has arrived when the wants of the community demand something of this kind; a time when the learned professions seem more than full; when the attention of our citizens, and in particular of our young men, is being more than ever directed to the cultivation of the soil; and when many both wealthy and liberal men in the Commonwealth are holding out the inducement of an ample supply of funds in furtherance of such an undertaking.

Influenced by these considerations, among many others, your committee respectfully recommend that a committee be chosen by this Board to apply to the present Legislature for an act authorizing the formation of a Board of trustees, capable of holding funds to be applied in establishing an experimental farm and agricultural school connected with it, designed to furnish instruction in every branch of rural economy, theoretical and practical.

B. V. French.
Seth Sprague.
John Brooks.

Acting on the recommendation in the above report, the Board appointed Messrs. French, Newell, Sprague, Wilder and Secretary Flint a committee; and, as a result of this

action, the Legislature incorporated the Massachusetts School of Agriculture, but no institution was established.

At a meeting of the Board of Agriculture, Oct. 15, 1856, Messrs. John C. Bartlett, Benjamin V. French and Secretary Flint were appointed a committee to take into consideration the propriety of having a text-book on agriculture, prepared under the sanction of the Board.

At the annual meeting, Jan. 5, 1860, Mr. Richard S. Fay offered the following resolution, which was adopted: —

Resolved, as the opinion of this Board, that a system of agricultural education should be adopted and form a part of the educational system of the State.

Following the adoption of this resolution, the Board chose by ballot Messrs. Simon Brown, Richard S. Fay and Marshall P. Wilder a committee to prepare a plan for carrying it into effect, and to report the same to the Board for further action.

At a later meeting, held Feb. 2, 1860, Dr. George B. Loring offered the following resolutions, which were adopted: —

Resolved, That the committee on agricultural education be and hereby are authorized to prepare an elementary manual of agriculture for the use of our common schools, to be submitted to this Board for approval.

Resolved, That the said committee be requested to cause to be introduced the aforesaid manual, when approved by this Board, into the common schools of Massachusetts, in the manner provided for the introduction of school books by the laws of the Commonwealth; and that said committee be authorized to apply to the Legislature for the passage of an act for the accomplishment of this object.

At a meeting held Jan. 10, 1861, on motion of Mr. Fay, it was

Voted, That the committee on the manual be authorized to accept a proposition from Mr. Emerson and Mr. Flint, securing to them the copyright of the manual as a compensation for their services in preparing the book, upon such terms as to price of the work to be furnished to public schools, farmers' clubs and

agricultural associations in Massachusetts as may be agreed upon by said committee.

At a meeting of the Board, Jan. 25, 1861, Colonel Wilder presented the following resolution, which was unanimously adopted: —

Resolved, That this Board approve of the Manual of Agriculture, submitted by its authors, Messrs. Geo. B. Emerson and Charles L. Flint, and recommend its publication by those gentlemen as a work well adapted for use in the schools of Massachusetts.

And at a meeting of the Board, Jan. 17, 1862, on motion of Mr. James S. Grinnell, it was

Resolved, That a committee of three, consisting of Messrs. Joseph White, Charles C. Sewall and Henry H. Peters, be requested to represent the merits of the Manual of Agriculture to the committee of the Legislature on education, on the order "To consider the expediency of including the elements of agriculture among the branches to be taught in all the public schools in which the school committee deem it expedient."

As a result of this action, the Legislature of 1862, by chapter 7, provided that "agriculture shall be taught, by lectures or otherwise, in all the public schools in which the school committee deem it expedient."

But it must not be imagined for a moment that all was plain sailing. There were to be found, even as now, those who sneered at book knowledge, or doubted the expediency of any such measure. Hon. Amasa Walker did not hesitate to say, in an address before the Worcester South Agricultural Society: "Farmers are the great mass of the people, and how can they, from their very numbers, be educated at college? And then the expense could never be encountered by the farming interest, nor could the sons be spared from the farms, nor would it be desirable to so break up their habits as farmers as to put them under one, two or more years' tuition at college. Besides, colleges are made for professional men, not for the people, and their mission never was and never will be to educate the million." Mr. Jackson said that if a boy learned to read, write, cipher and

spell, he would make an excellent farmer. What need of science? The good old way of his fathers was sufficient. It was only the old story told by George Eliot in the "Mill on the Floss," and it is Farmer John who speaks: "What I want," said he, "is to give Tom a good eddication, — an eddication as 'ud be bread for him. That was what I was thinking of when I gave notice for him to leave the academy at Lady Day. I mean to put him to a downright good school at midsummer. The two years at th' academy 'ud ha' done well enough, if I'd meant to ha' made a farmer of him, for he's had a fine sight more schoolin' nor ever I got. All the learnin' my father ever paid for was a bit o' birch at one end and the alphabet at the other."

And even our good Governor, who has charmed us this morning with his reminiscences of the past, is reported as saying that all this matter of agricultural education was mere nonsense, — that he had always said that the agricultural college would be a failure; that it could not succeed in the nature of things, for as soon as you educated a boy, he would leave the farm. Consequently, the conclusion he came to was, that all the education a farmer got he would have to get at the tail of a plow.

At the very first intimation of a movement in the national House of Representatives, looking towards the establishment of colleges for the benefit of agriculture and the mechanic arts, the Board of Agriculture promptly placed itself on record. At a meeting held April 7, 1858, it was

Resolved, That this Board do most heartily approve of the objects of a bill presented in the House of Representatives in Congress, Dec. 14, 1857, by Hon. Justin S. Morrill of Vermont, requesting Congress to donate public lands to each State and Territory which may provide colleges for the benefit of agriculture and the mechanic arts; and that our Senators and Representatives in Congress be requested to render their best aid in securing the passage of said bill into a law; and that our secretary be requested to serve each of our Senators and Representatives with a copy of the above.

At a meeting of the Board, Jan. 8, 1861, Mr. Levi Stockbridge of Hadley offered the following resolution: —

Resolved, That, in the opinion of this Board, the time has arrived for the inauguration of measures tending to the establishment of an agricultural school of high grade under the patronage of the Commonwealth.

At a meeting held the 25th of the same month, on motion of Mr. James S. Grinnell of Greenfield, it was

Resolved, That this Board, believing that the establishment of an agricultural school would advance the interests of agriculture in this Commonwealth, is disposed to give its influence to any well-directed plan for such a school.

Following this resolution, Messrs. Marshall P. Wilder, Freeman Walker, William S. Clark, Levi Stockbridge and Charles C. Sewall were chosen a committee "to co-operate at their discretion with any men or body of men who may have any plan for an agricultural school, and to present and report their proceedings at the next meeting of the Board."

At a meeting held Feb. 27, 1863, Colonel Wilder made a statement of the doings of the above committee. After some discussion, Dr. George B. Loring presented the following resolutions, which were unanimously adopted: —

Resolved, That, in the opinion of the State Board of Agriculture, the grant of land made by Congress to the several States for the establishment of colleges for instruction in agriculture and the mechanic arts is designed expressly for the general diffusion of useful knowledge in these two branches among the people.

Resolved, That the Legislature is hereby respectfully requested to make such disposition of the grant as will enable the Board of Agriculture, as immediately representing the farming interests of the Commonwealth, to enlarge its sphere of usefulness by exercising a supervision over the employment of the funds arising from the grant, for the purpose of securing the confidence of the agricultural community, and of conducting such a scheme as will operate for the benefit of those engaged in this business.

Resolved, That, in the opinion of this Board, the interests of the State and intentions of Congress require that the grant should be principally devoted to the establishment of an educational institution for the practical and scientific study of agriculture and for the instruction of youths who intend to follow industrial pur-

suits, and that the institution should not be immediately connected with any institution established for other purposes.

Resolved, That a committee of five be appointed to present these resolutions to the committee of the Legislature having the subject under consideration, and to express the views of this Board upon the proper disposition of the Congressional grant.

The committee provided for in the last resolution was constituted by the appointment of Messrs. Marshall P. Wilder, Paoli Lathrop, George B. Loring, S. B. Phinney, John Brooks, Henry Colt and Charles G. Davis.

At a meeting held Jan. 30, 1865, Dr. Loring offered the following resolutions, which were unanimously adopted: —

Resolved, That the Agricultural College should maintain an intimate relation to the agricultural societies and the farmers of the Commonwealth, as a means of disseminating practical information and affording the best means of educating young men for the business of farming.

Resolved, That, for this purpose, every effort should be made to connect the State Board of Agriculture with the government of the college, for the express object of bringing the agricultural societies into close connection with that institution, and as the most useful method of combining all the efforts of the Commonwealth in one system of practical agricultural education.

From this time on we find the Board taking the most active interest in the establishment of the college, providing in every possible way for its welfare, and seeking to enter into a closer and more intimate union. We can do little more than briefly enumerate these continued expressions of its good-will. We find it in 1866 the author of an act constituting the president of the college a member *ex officio* of the Board; and further providing that it should be constituted into a Board of Overseers over the college, but without powers to control the action of its trustees or to negative their powers and duties. In this same act the Board was authorized to locate its cabinet and library at the college, and to hold its stated meetings there.

We next find it in 1867 urging upon the agricultural societies to establish and maintain at least one scholarship at the college. As a result of this effort, we find in 1869

eighteen of these societies supporting a scholarship, while the Massachusetts held itself responsible for three and the Essex and the Plymouth each two. At this same time it advocated the proposal that each agricultural society should set aside one-sixth of the moneys granted to it by the State as a fund towards the support of a professor at the college, whose duty it should be to carry out such experiments as the Board might from time to time direct. A circular was sent out to each of the thirty agricultural societies, asking whether it would consent to such setting aside of one-sixth of its stated income. This proposition, however, failed to go into effect; and a resolution was then adopted stating that it was desirable that the secretary of the Board should be located at the college and become a professor, performing such professional duties as the trustees might direct, and receiving a competent salary from the Commonwealth. This resolution was reconsidered the next year, and the following resolution adopted: "That Charles L. Flint, the secretary of this Board, be authorized to deliver a course of lectures at the Agricultural College, or to discharge such duties connected with the instruction of the students at that institution, as the trustees may assign to him, provided that such services do not conflict with his duties as secretary aforesaid." Under this resolve Mr. Flint lectured at the college for four successive years, his name being carried on the catalogue as lecturer on dairy farming.

Again in 1875 we find the Board renewing its efforts to induce the several agricultural societies to each maintain a scholarship at the college, and to secure the attendance of one or more students from the district covered by their organizations.

In all matters of financial aid the Board by direct effort and petition to the General Court was a powerful support to the trustees. This was particularly manifest in the years 1868, 1869, 1876, 1877, 1882 and 1899.

When, in 1880, Governor Talbot and Council advocated the union of Amherst College and the Massachusetts Agricultural College, it was the Board that, under the leadership of Benjamin P. Ware of Marblehead, drew up a series of

resolutions embodying its adverse feeling; and again in 1881 it was the Board that directed its secretary to petition the Legislature to establish an experiment station at the college. In short, wherever we look we find the Board of Agriculture at the front, moulding public opinion and leading the way. For what it has purposed and tried to do, for what it has done in the past, for what it will do in the future, permit me, in the name of the college I represent, to express my grateful appreciation. With the Board for its councillors and overseers, its future is secured.*

The CHAIR. Every person present would have been delighted to welcome the second secretary of the Board, John E. Russell, and to have listened to his eloquent words. His health is such that he is unable to be present, but he has sent us a letter, with his greeting and some reminiscences, which Secretary Stockwell will read.

LETTER OF EX-SECRETARY JOHN E. RUSSELL.

LEICESTER, July 20, 1902.

Hon. J. W. STOCKWELL, *Secretary*.

MY DEAR SIR: — I am much interested in the celebration of the fiftieth anniversary of the organization of the Board of Agriculture, and it would be a great pleasure to meet the members, but my health will not permit me to appear in public.

The happiest and most useful years of my life were passed in the service of the farmers of the Commonwealth, and I look back with feelings of gratitude for their appreciation of my efforts and for the help they gave me. It is nearly twenty-two years since I was elected secretary, to succeed Mr. Flint, who had been the executive officer of the Board from the beginning; and of the members who assisted at my election but three are now in the service, — Mr. Hersey, Mr. Sessions and Mr. Smith.

The oldest man on the Board at that time, and one of the founders, was Marshall P. Wilder. I wish I could describe that venerable man, as he appeared to me in what might well be called the beauty of his age. His force was unabated and his enthusiasm unchilled by the frosts of nearly four-score years. He was of noble and commanding presence, and had the dignity and courtly

* For much of the data in this sketch I am greatly indebted to Mr. F. H. Fowler, first clerk, office State Board of Agriculture.

manner of the old school. He was devoted to the interests of agriculture, and his successes in practical horticulture were recognized over seas. Mr. Flint had been permanent secretary, and there was a natural feeling in the minds of the older members that he was necessary to the life of the Board. No proper person seemed to offer as his successor, and there was gloomy foreboding.

At this time of misgiving Mr. Wilder sent for Mr. O. B. Hadwen, the delegate from the Worcester Society, then one of the most efficient members of the Board, and asked him to find a candidate for Mr. Flint's place. Mr. Hadwen, without consulting me, proposed my name, which was unknown to Mr. Wilder. Then, with my glad approval, the nomination was submitted to a full meeting; and, though a complete surprise to most of the members, who had never heard of the candidate, Mr. Hadwen's advocacy was so effective that the election was unanimous, but with the understanding that in the future there should be an annual election, — which was a strong hint that the Board was by no means sure that the place was filled, and the new secretary was warned that he was on approbation. Though the scope and influence of the Board at that time was far less reaching than it is now, and its functions undetermined, its membership was able. The three members by appointment were Mr. Wilder, Dr. Nichols, eminent as a chemist, author and lecturer, and James S. Grinnell, whose doubts as to my fitness for the secretaryship were a proof of his superior judgment.

At the head of the list of societies as it then stood was the "old" Massachusetts, strongly represented by E. F. Bowditch, whose example and social influence were of infinite value; the Essex came next, with Mr. Ware; and the Middlesex followed, with Captain Moore; among the nearer and consequently more available members were Mr. Hadwen, Dr. Jewett, John Lane and Mr. Hersey, who, I rejoice to see, is still a member of the Board. The purpose of the members was to make the Board an active power, to bring it nearer to the life of the farmers, to increase its influence with the Legislature and to promote the welfare of the Agricultural College. With this view the Board had decreed the holding of three institutes annually by each society, and it was expected that the secretary would attend and conduct at least one of these.

There was much opposition to this rule; and to one distant and important society, which strongly disapproved of the interference of the Board, I made a journey in bitterly cold weather, and found an institute of three ill-humored, nagging individuals; and in the evening, at a free lecture, which I had expected would be adver-

tised by the society and attended by the members and their families, I had an audience of five persons, four of whom were ladies who knew me. This opposition was treated firmly but with good-nature, and was gradually overcome; the institutes became important, and were the best work of the Board; the latest information was disseminated; interest was kept up through the winters. I attended meetings from Nantucket and Martha's Vineyard to Berkshire, and, under the guise of a teacher, I was taught. In this work I had the association and assistance of the members of the Board; and I must especially mention the unfailing support of that eminent chemist, Professor Goessmann. From the establishment of the institutes the influence and work of the Board constantly broadened, and it secured a greater measure of the confidence of the Legislature and the Executive. My connection with it ceased in 1887. Since then I have been so much occupied in other affairs that I have not kept in touch with the farmers, but I have not been unobservant of their affairs; and though, like the rolling seasons, they cannot be hurried, I feel sure their progress is steady, and equal to the other permanent and useful pursuits of their fellow-citizens, and that they are more prosperous and living easier lives than they were twenty-five years ago.

I can never forget the busy years of my secretaryship, and the warm friendships then made with men most of whom have gathered their last harvests on earth and passed on to those celestial fields,

> Where everlasting spring abides,
> And never-withering flowers.

If I had my life to live over, it would be spent in practical agriculture, and in helping my brother farmers to a better appreciation of the most secure and happiest of lots.

Cordially yours, JOHN E. RUSSELL.

The CHAIR. Our time has very nearly expired, but we cannot adjourn without calling upon one man whom Secretary Russell mentioned as a valuable man in every way. He has served the agricultural interests faithfully as member of the Board, as trustee of the Agricultural College, as Cattle Commissioner, and as president of the Worcester County Horticultural Society; and he is now president of the Massachusetts Horticultural Society, which has invited us to occupy this building free of charge for this semicentennial. I call upon Mr. O. B. Hadwen of Worcester.

ADDRESS OF MR. O. B. HADWEN.

Mr. President, ladies and gentlemen, I confess that I am unexpectedly called upon, for it was not intimated to me that I should be asked to address this meeting until after I entered the hall. But I have been so delighted with the occasion of this fiftieth anniversary of the Board of Agriculture, in which for many years I have been deeply interested, that perhaps I may say a word.

I must allude to the part which the county of Worcester has had in connection with the Board. Originally the Board of Agriculture emanated from the Massachusetts Agricultural Club, in which Col. Marshall P. Wilder was a prominent member. It was in the Agricultural Club that it was first proposed that the State should have a Board of Agriculture, to assist the farmer in his application of principles to the agriculture of the Commonwealth. How far it has been successful I will leave it for you gentlemen, farmers, to say.

In those days, agriculture, though a prominent industry, was conducted on an entirely different plan from what it is at present. The course of operations pursued by our farmers was very different from what it is now. Since then the farmer has been taught to use both his head and his hands, and with the joint use they have contributed very largely to the success of agriculture as it is now conducted. Worcester County has sent many men to the Board. First was Amasa Walker, the first secretary of the Board, *pro tem.* He was succeeded by Charles L. Flint. He was not a Worcester County man, but he married a Worcester County wife, which perhaps was an equivalent. Then we have had other secretaries. John E. Russell was a Worcester County man, and we have now the present secretary of the Board, and we are very glad that he is in the office, — Mr. Stockwell.

The Board of Agriculture has had on it six or seven representatives of the old Worcester Agricultural Society. In the first place was John W. Lincoln, brother of the Governor. He represented that society, and died in office.

He was followed by an eminent farmer, Harvey Dodge of Sutton, a citizen widely known for many things in his day as an agriculturist. Mr. Dodge was followed by Mr. John Brooks of Princeton, formerly a Boston broker, who afterward retired to a farm and became a successful farmer. He used to have great influence with the farmers of the Commonwealth. Mr. Brooks was followed by Henry R. Keith of Grafton, a relative of Secretary Flint. He was followed by Thomas W. Ward of Shrewsbury, who was also a successful farmer. I followed Mr. Ward, and if I had spent six months longer on the Board, my term would have occupied one-fourth of its existence. I have had two successors, both men of prominence in our calling, — Mr. Hartshorn, who was a member of the Board for twelve consecutive years, and now by Mr. Ellsworth, who is now serving his third term, — both intelligent and progressive farmers, improving every opportunity for the success of the Board. Great changes occur by the evolution of time, but five men are now living who were my associates when I first became a member of the Board, thirty years ago, and but three are now present to enjoy this interesting occasion, replete with the progress of the past and hope of the future.

From its early beginnings the Board has continued in its great work to the present time. It has assisted the Agricultural College, in which it has had great interest, which has turned out many young men who are now engaged in the pursuit of agriculture, and are instructing others to be farmers. The college itself, its grounds and its surroundings, is an object lesson by which we have all profited.

Let me congratulate you that you have the pleasure of attending this fiftieth anniversary of the Board of Agriculture; and, while we have made progress in the last fifty years in many directions, still, we have made less progress in others; and the fifty years that are to come will find the State engaged in many different pursuits in agriculture from those in which it is engaged at present. We shall get back nearer the soil in the next fifty years, and I have no doubt that we shall be more prosperous. As I said in beginning, farming methods to-day are very different from those which

were in use when the Board was organized. Farmers to-day live in better houses; everything around them is better; they understand the principles of agriculture better; their lives are more comfortable: they can do more work in their fields; the employees on the farms live in better condition than they did then; the life of the agricultural classes is improving. If you will take note of the men who are pursuing this calling, you will question whether there is any other body of men who get as much out of life; you will conclude that they get more out of it than any other class of men on the face of the earth.

This closed the forenoon exercises, and upon invitation of Vice-President Sessions the company passed into the adjoining hall, where dinner was served. Mr. Sessions presided, and conducted the after-dinner speaking. The first speaker of the afternoon was Hon. James J. Myers of Cambridge, speaker of the House of Representatives.

Speaker Myers referred to his first fourteen years of life on a farm, to his sympathy with the farmers, and his appreciation of the hardships which farmers endured before farm inventions lightened their burdens. He spoke of the rapid progress of invention to improve the condition of farmers, and congratulated the Commonwealth upon its agricultural prosperity. He also spoke of the need of a high character of American citizenship, and urged upon the company devotion to an active, public spirited life.

Next was presented Mr. Edmund Hersey of Hingham, as the oldest member of the Board in length of service. Mr. Hersey expressed his acknowledgment, but said that his voice would not permit him to continue.

Mr. Benjamin P. Ware of Marblehead was introduced as another veteran in the service. He congratulated the Board upon the prosperity of agriculture, and spoke of the long and valuable services of the Board of Agriculture, of the experiment station, of the growth of the dairy enterprise, and exhorted the farmers to be watchful for their interests.

Capt. Rufus G. F. Candage of Brookline was next pre-

sented. His leading thought was the great advancement in agricultural methods during the fifty years of the life of the Board.

Mr. C. K. Brewster of Worthington followed, whose principal point was the value of the Agricultural College to the farmers.

Mr. Walton Hall of Marshfield, who lives on the farm formerly occupied by Daniel Webster, spoke of the great progress which is yet possible for the farmers, notwithstanding all they have thus far accomplished, and said that farming was never so prosperous as to-day. It is not only in manufacturing that Massachusetts is prosperous, but she has abundant reason for prosperity in her agricultural resources also.

Mr. Augustus Pratt of North Middleborough was the next speaker. He gave reminiscences of the introduction of the mowing machine, and contrasted former farm conditions with those of to-day, with improved inventions and better times for labor. He saw great cause for congratulation in the progress of the fifty years.

Prof. F. W. Rane of the New Hampshire Experiment Station praised the work of the State Board of Agriculture, and told how well it was known; how it has caused enthusiasm to spread to other States, and how it made the future of agriculture look bright.

Mr. Geo. S. Ladd of Sturbridge, master of the State Grange, referred to the fact that members of the Board are members of the grange also, and that there is close identity of interest between the two bodies, as well as identity of membership in many instances.

Mr. W. A. Kilbourn, representing the Worcester East Agricultural Society, noted the vast improvement from the sickle and scythe of his early days to the improved implements of to-day. He thought his successors fifty years hence would have other wonders to chronicle.

Representative W. C. Jewett of Worcester referred to the good work of the Board in the suppression of the gypsy moth, and thought that it had given a good account of itself. He thought that no other body could do the work of the Massachusetts Board of Agriculture.

Mr. Geo. M. Whitaker, general agent of the Dairy Bureau of the Board, was called as a representative of the agricultural press. He spoke of the great growth of agriculture during the fifty years of the existence of the Board, and of the scientific basis of its operations compared with former years, and praised the successful work done by the State Board for the advancement of agricultural interests.

Prof. J. W. Sanborn of New Hampshire followed. Agriculture's great growth was his leading theme, and the future of agriculture was regarded in a most hopeful light. He thought that it would be one of the foremost of industries, that the range of agricultural knowledge would be greatly increased, and that New England would gain conspicuously in comparison with other parts of the country in the relative value of her agriculture.

State Senator C. B. Williams of Wayland made the point that whatever criticism of the Board was honest ought to be met manfully. If it were well grounded, it would be of benefit to the Board to pay attention to it; if it were not well grounded, it would fall of its own weight.

Mr. George Cruickshanks of Lunenburg, presented as one of the oldest ex-members of the Board, said that he congratulated the Board upon its fiftieth anniversary, but he did not come prepared to advise the Board.

Mr. Geo. M. Baker of Marshfield, who was called as the oldest ex-member of the Board, said that he looked upon his connection with the Board as one of the pleasantest memories of his life.

Mr. F. L. Whitmore of Sunderland cautioned the farmers against those who were engaged, not in farming the land, but in farming the farmers.

Prof. Wm. P. Brooks of the Agricultural College said that the soil of Massachusetts is not declining, but it is a hard soil to work. He spoke of the worth of the men who are raised upon the farms of Massachusetts, and said that our New England farms are a school for men. They are trained for service, and service is the key-note of the gospel which is preached to-day. It is true that he who makes two blades of grass grow where only one grew before is a

public benefactor; but the Agricultural College has conferred a greater benefit upon the public, by the service which it has rendered to the young men of the farms of New England. In the next fifty years it may reasonably be expected that the conditions of farms and of the farmers will be greatly improved.

Mr. Elmer D. Howe of Marlborough, former master of the State Grange, prophesied a broader future for the farmers of New England, and quoted Albert Shaw as saying at Leland Stanford University that there was no better place for bringing up children than a New England farm.

To conclude the exercises, Chairman Sessions called upon Secretary Stockwell of the Board, who, after referring to his remarks as the closing ones of the day, continued: —

I know we have all enjoyed this day. It has been a day of reminiscences, a day in which we have taken account to some extent, but not a full account, by any means, of the work of this Board of Agriculture of Massachusetts. The Board of Agriculture is as dear to us now as in any year of its existence. The future is before us. The people are looking to us, and they have a right to look to us; they have a right to hear what we are doing, what work we are accomplishing, to make the agriculture of the State better. If we look forward, true to the interests of our calling and the interests of the State, we cannot fail. The future has great possibilities. It is estimated that this century will bring us a population of 200,000,000 people in this country. Other countries will increase in population also. In this century, if we are reaching forward from a population of 80,000,000 to 200,000,000, then the agriculture of this country must also develop accordingly with its full strength in order to satisfy the demands upon it. In the last fifty years we have sent out 80 per cent of the exports of this country. That has been the proportion of agricultural exports. So it must be in the future. We of the Board of Agriculture are just learning the future possibilities, the future openings for our products, and we have got to meet these opportunities promptly. We believe that the Board of Agriculture of Massachusetts will stand in the years to

come, in the coming century, as it has stood in the last fifty years, the leading Board of Agriculture in the United States in promoting the cause of agriculture and in increasing the agricultural products of the State.

I wish I could express to you the pleasure it has been to me to be here to-day, and look upon your faces and realize the pleasure I hope you will all derive from this meeting. Now, as we separate, I hope you will return to your homes full of the spirit of enthusiasm for the cause in which we are engaged. Agriculture to-day is looking brighter and the prospect is better than it has been in any year of the past decade. So we await the benefit which the future has to bestow, confidently, patiently and cheerfully.

Mr. John G. Avery of the Spencer Society moved a vote of thanks to the Massachusetts Horticultural Society for the use of its building for the semi-centennial exercises. Secretary Stockwell seconded the motion, saying: —

I want to express the very great pleasure which the Board feels for this hospitality. It was granted courteously, kindly and freely. We are under very great obligations to the Massachusetts Horticultural Society. I am glad we can express it in thanks, if nothing more.

Chairman Sessions. It is a pleasure to me, as presiding officer, to add my voice to the words of the secretary. The Massachusetts Board of Agriculture and the Massachusetts Horticultural Society have from the first been more or less closely interwoven. It is well known to you that Marshall P. Wilder was one of the original members of both of these organizations. May the future see them continue together in their work for the good of agriculture, which includes horticulture. I call for the adoption of the vote of thanks moved by Mr. Avery.

The motion was carried unanimously, and the gathering then dissolved.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

NORTH ADAMS.

DECEMBER 2, 3 AND 4, 1902.

PUBLIC WINTER MEETING OF THE BOARD,

AT NORTH ADAMS.

The annual public winter meeting of the Board for lectures and discussions was held at Odd Fellows Hall in North Adams, on Tuesday, Wednesday and Thursday, December 2, 3 and 4. The meeting was called to order by Secretary Stockwell at 10.30 o'clock A.M., who introduced First Vice-President Wm. R. Sessions as the presiding officer. Prayer was offered by the Rev. Mr. Tenney of North Adams.

The CHAIR. We as a Board are enjoying the hospitality of this city, the young giant of the north-western part of our State, and the Mayor has come to give us the address of welcome.

ADDRESS OF WELCOME BY ACTING MAYOR WHITAKER.

Mr. President, and gentlemen of the State Board of Agriculture, and fellow-citizens, I am very glad to look into your faces this morning and welcome you here to North Adams. When our friends from outside come to visit us we are always very anxious that North Adams should put on her best looks, and to see the sun coming out so brightly this morning is a pleasure to us as well as to yourselves.

We are very glad to welcome you here to-day, to take up and discuss themes concerning agriculture, because that is one of the weak points here in North Adams; and to be strengthened right there is one of the things that we look upon as a pleasure; and so we cordially and gratefully welcome you here for this reason.

North Adams is not specially an agricultural section. Our lines are more drawn in the manufacturing lines. We

excel, if in anything, right there. I understand your mission here is to help us in developing along the farming line, and to give us thoughts in relation to our work in that line which shall be helpful, strengthening, stimulating; and so we are anticipating quite a good deal, and trust that before you get away from here we shall know far more as to what is better for us to do in the agricultural line.

One going about North Adams, around these hills, would feel that there was very little territory that could be cultivated to great advantage. Our farms are right up on the side hills; we haven't plain land as in the far west, and we feel that we are at a disadvantage in that line. But, nevertheless, we do welcome all the best things that can come to us in the line of agriculture. We are always anxious to know how to do things and to do them well, and we shall listen with much interest to the discussions brought forth during your State meeting.

Two friends were once travelling in Switzerland, and as they went along the highway one said to the other, "Look up there; there is a fine farm up there." And it did look fine from a distance, but it was way up in the air. And so in North Adams you will find a great deal of the territory to be cultivated is up on the side hills; but with the use of a good deal of common sense things can be made to pay here; and so we are very glad to take into consideration the topics you have on your programme to discuss.

We have always felt here in North Adams in regard to any line, especially the manufacturing line, professional line, etc., that we could not go too far in knowing what our business was. To have the advantage of all the best thinking and of the best methods we always have believed to add strength to us. And so even though we are not a great agricultural community, those who are interested in that line will feel pleased to know the best way to do things to accomplish the desired ends. And as I look upon the corn here this morning it seems to me it only needs good common sense in regard to the way to do things, and the results will be sure to show themselves.

I was asked this morning if I had my speech all written

out so it could be printed. I had no idea I was to make a speech; all I came for was to give you a hearty and cordial welcome to North Adams. I want you to enjoy yourselves and to feel at home, to feel free to look into anything we have, to inspect anything that may interest you, especially in the agricultural line; we want you to look at that and give us your suggestions. The manufacturing interests in North Adams are always worth while for visitors to look into and examine; and we know the doors of our mills, and everything relating to our mills, will be open to you; and so we cordially invite you to look into anything that will interest you in that line.

The old Berkshire hills are always interesting to look upon. If you can find time to go about our streets and get on to our hills and look at our fine views we shall be glad to have you do that; and when you leave North Adams we hope you will go away feeling that you want to come back again and see the old hills once more.

RESPONSE FOR THE BOARD OF AGRICULTURE BY FIRST VICE-PRESIDENT WILLIAM R. SESSIONS.

Mr. Mayor, citizens of North Adams, and members of the Board of Agriculture, in reply to this cordial and hearty welcome of the mayor you do not expect a long speech from me, and if I were to undertake it you would wish for something else.

I am reminded as I look over this populous city, this place where so much is being accomplished, so many earning their living and building up their interests, — I am reminded of the first time I came here. I came over the mountain in a four-horse omnibus and enjoyed greatly the beautiful views all along the way. At that time North Adams was a parish of the town of Adams; to-day it counts its population by thousands, — 25,000 I believe, — and the change in the lifetime of the man who does not seem very old to you seems something wonderful.

This Board has had quite a long life. Its fiftieth anniversary was celebrated last summer. The achievements of the Board were looked over at that time and related with more

or less thoroughness. But I want to say to the mayor and to the citizens of North Adams that this Board has not been a theoretical Board particularly; it has been a practical Board from the beginning to the end. From the beginning of its work in Massachusetts every branch of agriculture has been represented on this Board by men who have been eminently successful in the practice of agriculture, and in their special lines of work as well.

In the early days we knew little about the science of agriculture as it is now given to us. We had no experiment stations to bring to us long-tried experiments and the achievements of successful men in agriculture; but if you will look over the reports for the last forty or fifty years you will find that men successful in the agricultural line gave us the results of their investigation line upon line and precept upon precept, and that backed up by experience. Later we have the agricultural college and experiment stations to bring to us the reasons for things, — things which some of us knew before but were not able to give the reasons for. They told us not only what to do but why, and agriculture has been advanced all along the lines for forty or fifty years. We hope that we may leave a little influence here that shall be to the advantage of the local agriculture.

It has been the custom of this Board to hold meetings in different parts of the State in order that farmers from all over the State may have the advantage of the meetings. This is the fourth time we have come to Berkshire County, and the first time to North Adams.

The gentleman who is scheduled to give us the first lecture has not only experimented in agricultural colleges and experiment stations, but in his mature years has started to show, by practical illustrations, the things he has taught, and is now demonstrating the truths which the experiment stations and colleges have spread broadcast.

I will now introduce Prof. J. W. Sanborn, of Gilmanton, N. H., who will speak upon "Beef Production in New England."

BEEF PRODUCTION IN NEW ENGLAND.

BY PROF. J. W. SANBORN, FORMERLY DIRECTOR OF THE MISSOURI AGRICULTURAL EXPERIMENT STATION, PRESIDENT OF THE UTAH AGRICULTURAL COLLEGE AND DIRECTOR OF THE UTAH AGRICULTURAL EXPERIMENT STATION.

Are the present prices of beef and the promising outlook for beef production in New England due to permanent causes, or are they based upon transitory conditions? If new industrial agricultural conditions are at the root of the high prices of meat products they demand close attention and call for a new attitude on the part of our farmers towards the stock industry. The mighty expanse of free ranges laden with crops accumulated in an arid region, where they dry in perfection and remain palatable for a considerable period, afforded stock food at so nominal a cost as to have made nearly impossible competition by those living on high-priced lands and inadequate pastures. It practically obliterated beef production in New England.

It is probable that the corn shortage of 1901 of nearly one-half the usual production has aided the natural tendency to enhanced prices of beef, and that a return to normal crops will have a modifying influence on prices of meat products. The basic cause of the present satisfactory prices of meats is found in a constantly decreasing ratio of meat animals to population. From 1892, when the number of meat animals in the United States reached high-water mark, there has been a steady decrease in total number raised for the shambles.

	Cattle.	Sheep.	Swine.
1892, ...	37,651,239	44,938,365	52,398,019
1899, ...	27,994,225	39,114,453	38,651,631

The great live-stock markets have shown this year, despite the allurement of exceedingly high prices ($8.40 per 100 pounds live weight having been reached in Chicago), a marked decrease in receipts over last year, and over preceding years for nearly a decade. Low prices, averaging for the country for cattle other than cows at the lowest point for a decade in 1895, but $14.06 per head, no doubt discouraged breeders, and in part explains a decline of 9,667,014 cattle in the seven years from 1892 to 1899; but the constant rise from 1895 to 1899, from $14.06 to $22.79, failed to induce an increase in total numbers, or even to check the phenomenal decrease of stock. The present higher prices, nearly double those of 1895, make it evident that this further rise in prices has not given a sufficiently upward turn in the numbers of beef animals to meet growing demands for them.

I have not quoted from the last census, as the basis of enumeration was changed and the proper basis of comparison destroyed. The statistician, however, regards it as probable that a loss of neat cattle of from 7 to 9 per cent occurred during the decade from 1890 to 1900. This decrease was accompanied by an increase of population of 21 per cent. The most significant feature of this probable decrease of neat cattle from 1890 to 1900 is in the location of the loss. It was found to be greatest in the great free-range section, from whence has come the severest strain upon our beef producers. Is this loss due to the unprofitable character of the range beef production? No, but from the decreasing capacity of ranges. Settlers have withdrawn large areas and are constantly making inroads into the grazing section. Further trouble awaits ranchmen. Government is ordering fences down and rental rates are impending.

The chief cause of the decline of cattle is found in the character of the grass and atmospheric conditions. In this rainless area grass may accumulate and hold its quality and palatableness, as rains do not deteriorate it. Once the surplus is grazed off only the annual production can be had.

The insufficiency of moisture by the law of the survival of the fittest gives first place to the bunch grass, as a close

mat of grass has a heavy vaporizing power. Once grazed off, vaporization from the soil direct occurs. Grazing cattle pull at the roots, and injure this bunched grass by trampling as they do not over close matted grazing areas. These and other causes account for the fact that, on ground where cattle can be grazed the year round free of rental expense, the numbers have been greatly reduced.

It is to be especially noted that during the brief period occupied in stocking the ranges their breeding stock and young things were constantly being absorbed by the increased area annually occupied. When it became occupied in full all at once a great increase of range-fed cattle in eastern markets occurred. Prices went down, down, to rates impossible to duplicate by eastern feeders at a profit. This discouraged even range sales, and cattle, so far as conditions would admit, were held back, spreading low rates over years of time. At last the readjustment of cattle to range capacity is practically completed, except so far as settlers and agricultural methods modify the situation. This adjustment is upon the basis of greatly reduced numbers in the face of rapidly increasing population, and a constant absorption of range area into tillage farms. The range as a menace to beef production on farms has passed into history.

The steady increase of meat consumption with the increase of wealth bears materially on the prospective relation of meat supply to consumption. More meat is consumed per capita in both Europe and this country as the years go by and wealth accumulates. The relation of wealth to meat consumption is well illustrated by Italy in its consumption of only one-sixth the meat per capita of that of the United States. Again there is an irreconcilable conflict between man and domestic animals. This is settled by the Hindoos by their religion, which is in fact in opposition to meat consumption, making sacred much of animal life.

Under average conditions as now existing in New England it requires 5½ acres of ground to maintain a steer one year. It is probable that 300 pounds will represent the average yearly growth. By German data 149.1 pounds of this is

offal and hide. Of the balance, 22½ pounds are bones. Of the 128.4 pounds remaining, 73 per cent, or 94.63 pounds, is water. The remainder, 33.79 pounds, gives of edible water-free food but a production of 6.14 pounds per acre. It is probable that American data will show a better ratio of edible parts and may increase the amount a pound or so. The average production of wheat for this country, in round numbers 12 bushels per acre, gives roundly 500 pounds of digestible water-free food. After making more than adequate allowance, more than fifty-fold the nutrition can be grown with wheat than is secured by steers.

This means much now that our free areas have been overrun with cattle. Population is increasing about a million and a half annually, and will require of increased area to furnish it with its per capita of meat more than a million acres of land or a deepening of the use of that now held. This increase must come largely by the latter process. This means annually increasing costs to the regions that have competed with us, and a continuing development of conditions under which beef may be raised here. Ultimately, if the population of the globe continues to increase as now, beef consumption must necessarily decline.

But may we not expect a competition from the agricultural west, the corn-growing west, — with its cheap grains for our markets, at rates unattractive to us? It appears that range competition repressed beef production in these States, as in them all there was a decline in cattle other than cows from 1890 to 1900. It is significant that this decline was coincident with exceedingly low prices of corn. Beef production in the corn States, at rates prevailing from 1892 to 1900, was not satisfactory, and any material increase in numbers of cattle cannot be expected under similar conditions. But there are those that will maintain that the great corn area of the United States, close to the supply of cheap protein foods, gluten, bran, middlings, linseed meal and cotton-seed meal, can override all competition, and at best make it very discouraging to New England beef producers.

The present cost of shipping a 1,500-pound steer from Chicago to Boston is $4.20. The cost to ship the same from

the average distance of his growth to Chicago will be as much more. Commissions and other costs will bring the total up to at least $10. This much for the tariff of distance in favor of the New England steer. Is it enough?

If we regard the producer of beef as a purchaser of all the feeds given it is not enough. It will require, in round numbers, 7½ tons of food to grow 1,500 pounds of steer. More than $10 more would be required to purchase this food here than in the west, the hay costing here double what it will there.

But we logically and correctly must view the feeder as the farmer marketing his own products on his farm through the steers in question.

In the west the hay feed may at market rates be sold or charged to the steer at a loss, while here at our rates at a profit. The transaction must be regarded as a whole.

Will the same amount of energy or expenditure here produce 1,500 pounds of steer that is required to produce him there, and lay him down in our market?

The writer is pursuing a rotation of crops so far developed as to give fair warrant to the belief that 7½ tons of food, the amount estimated as required to produce 1,500 pounds of live steer, can be grown to advantage on 2½ acres of ground. Can the western producer grow this food on 2½ acres of ground more than $10 cheaper? In either case the feeders will have equal advantage in the manure produced for use on the farm and essentially the same cost of application.

The eastern farmer will have $4 per acre to expend for chemical fertilizers or plant food. Under wise management I do not hesitate to say that in a short series of years the New England producer would have the more productive farm, or, in other words, that he would be able to produce more beef per acre than the western feeder. Our soils have, under intensive methods, equal capacity of production and greater retentive powers.

The cost of tilling an acre of ground here may be slightly more than in the west, possibly a half dollar an acre more during a rotation period per year, and the protein foods

essential for the rations in the early days of our steer are more costly. Possibly another extra $1 per acre will thus be absorbed. It is railroad policy to make long hauls cheap, and wholesale transactions to far-away buyers are on a lower scale of prices. Bran often sells by the car here within one or two dollars of local prices in the States from which it comes, while cotton-seed meal is but a little more in Boston than in Chicago. Gluten is shipped from Chicago to New England points for $3.90 per ton. At feeding points in the west it costs nearly as much. Aside from home-grown corn not over one ton of protein foods need be purchased. This seems like a partial second expenditure of the $10 advantage of location, amounting, for tillage and grain, to $3.75 for the 2½ acres, leaving a net of but $6.25, or $2.50 per acre, to bring, with the manure produced, our land alongside western land in yield. This would pay for 130 pounds of acid phosphate, 30 pounds of potash and 50 pounds of nitrate of soda per acre annually. It is adequate to place our land on a parity with western land, and, in the end, before it in point of production.

Abundant experiment station investigations in the west show that the addition of manure to soils there producing no more than ours as ours are now treated, gives but a meagre gain in crops. Manuring does not increase crops as it does here, and in my experience is not as enduring. The intensive farming proposed, returning the excreta of well-fed steers and including an annual application of 190 pounds of chemical manures, adds wealth to our soils, increases our crops and incomes. There are unpresented factors that disturb the calculation, such as cost of marketing our stock on the one side and the superior value of sale crops grown in any proper rotation here on the other. The balance will fall on the right side when all the other factors are considered.

I have handled cattle in a very rich section of the Mississippi valley and also in the ranch region, and am successfully building up a New England farm, and do not indulge in forced or merely speculative reasoning. It is possible to grow as much beef per acre in New England, at as good profit to him who produces the food he consumes, as is

grown westward. We may feel assured that a higher range of prices is to prevail for reasons stated, namely: —

1. Our population is increasing rapidly, while beef production is stationary or losing ground.

2. The vast free-range area has been absorbed, reached its limit of beef production, and far past it, and is on a heavy decline.

3. The corn-growing and beef-fattening area of the west found beef production under past rates unremunerative, and reduced its herds.

4. It may be added that world-wide economic forces — increase of gold per capita, decline in rates of new lands being taken up, increased ratio of urban people, general rise throughout the world of the purchasing power of the masses — and other causes tend to a rise of prices in all farm products.

Wherefore, then, existing conditions?

When the free ranges poured their first and fullest products upon us, and the free open prairie of the corn States yielded hay for the taking, and our sons and money sought these opportunities and the new life and new industries of our expanding cities, eastern agriculture became discouraged, especially that part of it that felt the keenest edge of competition, — beef, mutton and wool production. The butter type of cow came in and the beef type went out. In great strides the west passed us in the art of breeding and feeding for beef. Outside of the market-gardening area in New England, or in the area where beef making may find an appropriate sphere, agriculture has not kept pace with its opportunities.

The Essentials of Success.

Successful beef production in New England must rest upon —

1. A more intensive agriculture.
2. Better bred steers, — the good steer.
3. Better fed steers, — early maturity.
4. Better pastures.

Successful beef production in the twentieth century sense

of that which constitutes success is possible only when accompanied by good to high farming. The ordinary 160-acre farm in this section cuts but a ton of hay per acre on some 30 acres, and requires 5 or more acres of pasture land, infested with weeds and bushes as they are, to carry a steer, and this by hard work on the part of the steer.

The food if of low quality, and, in total, home-grown supply, will not carry more than a dozen animals. Slow growth and heavy cost of attendance per animal fed eliminate all hope of true profit. To care for 12 steers at $1.25 per day involves a cost per steer for care of 10½ cents per day, or $10.51 for 100 days, — a fatal cost. Triple the number and this cost becomes but one-third its former amount. To compete successfully with the west there must ever be in view the acre product of beef. To make it as great here as there imposes the necessity of a modern tillage rotation in which the rank growing annuals occupy a conspicuous place. These give variety and great acre production of food. Unless the soiling system, which I do not deem desirable, is adopted our pastures must be completely made over. It is not possible to make beef successfully on average New England pastures for reasons that will appear further on. They must be rotated with the fields, and made fertile and luxuriant, carrying well a steer to the acre, and good for 2 or more pounds gain daily for five months, or when not tillable cleared of bushes and weeds and treated with chemicals.

A 1,000-pound steer, according to German investigations, contains but 23.18 pounds of nitrogen, 16.52 pounds of phosphoric acid and 1.84 pounds of potash. If such a steer grows 300 pounds in a season he will take but 6.9 pounds of nitrogen, 4.8 pounds of phosphoric acid and .54 of a pound of potash from the soil. These amounts can be supplied in 44 pounds of nitrate of soda, 30 pounds of acid phosphate and 1 pound of potash salts. Nature, however, by rains for nitrogen and soil solution for the potash and phosphoric acid annually supplies a part of these materials. After fertility has been raised by liberal applications of chemicals the annual or periodic supply may be light. As

this matter is presented elsewhere in this volume it is desired simply to call attention to the matter here.

Good pastures and the richer and more varied foods of a tillage rotation of higher farming are prerequisites to the successful introduction of the good steer and his early maturity.

Without the good steer early matured profitable beef raising in the east is utterly hopeless. Indeed, all else right, failure is sure without a good steer and early maturity.

The Good Steer.

In experiments made by the writer with several breeds of beef types and with typical scrub steers it was shown that a pound of food made similar growths for the several breeds and scrubs. Since then these results have been confirmed. But breed does not go in wholly at the mouth, for type is not made by food but by blood or inheritance. Type determines market prices, everything else being equal.

A good steer must have form, — deep and broad in the twist or thighs, thick through the crops or behind the fore shoulders, broad across the loins, well sprung ribs and straight round barrel. A Jersey or dairy type of steer, with flat ribs, sharp, thin shoulders, thin crooked thighs and narrow loins will not sell within from 1 to 3 cents as much per pound as the beef type. The one carries a large ratio of high-priced meat, the other of low-priced meat. In the one case a 1,500-pound steer will bring, when rightly fed, $105 to $120 on present markets if perfected. The same weight in the dairy type would not bring more than $80 to $90.

The Iowa Experiment Station fatted steers and submitted them to the judgment of Chicago experts, who gave them careful investigation. At that time cattle were lower, and the beef showing best quality was rated at $6.12½ per 100 pounds live weight, while the Jersey beef was adjudged worth $4.50 per 100 pounds. The former amount is 46 per cent more than the latter. This is a fatal difference. Other stations have shown a great difference in favor of the beef types. The Kansas station on one Jersey against one or

two of each of other breeds alone has been awarded as high points for the Jersey or dairy type. But one animal, and this standing alone among all other judgments, cannot be accepted as of any worth.

There is profit in the best type and loss in the other. We must command the best or avoid the business. One-half the trouble with beef production east is in wasting good food on poor foundations. The quotations of present markets show a range of prices varying 33 per cent on steers and oxen. All food at present prices put into the poorer steers is put there at a loss, yet this is the type prevalent in New England.

The west is putting its cheap food into the very best type of modern beef-producing machines; we, high-priced food into the poorest.

While there is but little difference in the growth made by the several breeds for a given amount of food, the variations between individuals may be marked in their power to consume, digest and assimilate food. Thus in two lots of steers fed by me at the New Hampshire Experiment Station it was found: Lot 1, first period, ate 2,172 pounds of hay and 440 pounds of grain, and gained 65 pounds; Lot 2 ate 2,500 pounds of hay and lost 12 pounds. Lot 1, second period, ate 2,725 pounds of hay and gained 113 pounds; Lot 2 ate 2,145 pounds of hay and 500 pounds of grain and gained 117 pounds. It will be seen that Lot 1 in the first period used the grain partially as excess food, while Lot 2 in the second period used 500 pounds of grain in exchange for 585 pounds of hay. Lot 1 ate in the two periods 5,335 pounds and required 30 pounds of food for 1 of gain, while Lot 2 ate in both periods 5,145 pounds and required for 1 of gain 49 pounds of food.

Those steers weighing 1,000 pounds were not, as will be seen by the ration, fed for rapid growth but as a test on moderate rations of individual capacity to use food. Steers of good appetites and digestive and assimilative powers must be bred and selected.

Early Maturity.

Early maturity is the one factor of supreme importance in beef production, and our weakest one. Profit making from four and five year old steers has gone into oblivion with the post auger and hand reaper; it is only known where beef making is in great decrepitude or where food is practically free. The only beef that we can hope to make is baby beef. Thirty months should be old age for steers in the east, and at twenty to twenty-four months they should be in their prime.

The philosophy of young beef is obvious. It requires about 16 pounds of food to maintain the existence of a 1,000-pound steer without growth. Unless more is given all is thrown away. If 17 pounds is fed, or 1 pound more than maintenance, growth occurs, and 6¼ per cent of the food given is productive. If 18 pounds, or 2 pounds excess food, is fed, then 12½ per cent of the total ration is productive force. The addition of the second pound of food adds 100 per cent to the efficiency of the first 17 pounds. If 30 pounds is given and eaten, as it may be, then 14 pounds excess food over the food of existence is taken, and 53⅓ per cent of the food given is directed to the processes of growth. No folly is greater on the part of the feeder than scanting food, or giving a maintenance ration, or just a little more.

On our poor old pastures the hard task of grazing a living induces the steer to limit the struggle to little more than existence. Much goes to run the animal machine and little to growth, and an enormous waste results. Low feeding prolongs the period of growth from two to four years. Birth weight, considered the average weight of a 1,500-pound steer during growth, is about 720 pounds. Maintenance for such a steer is 11½ pounds daily. If four years are required to fit him for the shambles instead of two years, maintenance ration is lost for two years. This amounts to 4 tons 395 pounds. As this is the New England style of beef production, in this factor alone is found loss enough to ruin the business.

Type and Time.

The combination of a good type of steer with quick time of maturity has another important bearing. The good type can be sold at full market rates at less weight and therefore in less time than can the poor type. This is important, as the larger an animal grows the more it costs to make a pound of growth.

At all of the fat stock shows this truth is shown. It is an obvious one because the larger the steer the more the food required to run the machine. Fifteen hundred pound steers will require 22 or more pounds of food for existence without growth, while I have made in calves a pound of gain on 4 pounds or less of food. At the Chicago Fat Stock Show calves under 297 days gained 2.63 pounds daily, year olds gained 2.18 pounds, two year olds gained 1.74 pounds and three year olds gained but 1.97 pounds daily, according to Professor Henry.

On the other hand the Michigan station found that it cost $4.03 per 100 pounds of growth for calves, $7.98 for year olds and $12.54 for two year olds.

In some experiments made by the writer at the New Hampshire and Missouri State colleges it was found that a pound of gain required a constantly increasing amount of food as calves increased in weight. Thus two calves, requiring when weighing 322 pounds 8.3 quarts skim-milk for a pound of gain, at 385 pounds weight required a pound of added meal to maintain the growth, a little later 2 pounds of grain, and at 512 pounds weight they were eating 5 pounds of hay in addition. At 638 pounds weight they had reached, in addition to 20 quarts skim-milk and 3½ pounds grain, the consumption of 9½ pounds hay without added gain. Year olds weighing 750 pounds required 19 pounds hay for 1 of gain, two year olds of 1,000 pounds weight required 25 pounds hay for 1 of growth. Elaborate trials with swine have shown the same truth. The larger the animal the greater the machine to keep in motion and the more the tax of mere existence. Breed for perfection of beef form, and feed for finished beef at the highest weight the market will accept at full prices.

The heavy percentage of the ration required for maintenance makes it imperative that there shall be continuous growth from start to finish. All fat and lean periods must be resolutely eliminated. The fattening period properly begins when the calf is born, if not before. This demands barn feeding until full pasture feed and during early fall months. The year the steer is finished for market grain should be fed at pasture, and must be fed each year until ideal pastures are secured if baby beef is to be made. I have seen in Missouri corn constantly before steers in pastures where the Kentucky blue grass was "up to the eyes," — as high as 500 pounds growth being made in the grazing season. Such feeding ultimates in good pastures. The advice to grain feed steers at pasture will appear radical; but the solid beef, well marbled, that now brings 8½ cents a pound in Chicago, 1,000 miles west, while ours sells for 1 to 3 cents less in the final market here, is a type of beef to be had only by such feeding, and will pay us to produce.

Those feeling that our pastures are too valuable to throw away, and that it is too costly a process to make them productive, must bear in mind that the grass is shaded by weeds and bushes, is of low feeding value and that it is hard work at grazing for even a moderate growth of steers. Maturity of steers fed on them is put over a year, and carries with the delay the necessity of feeding maintenance food for this time, and, furthermore, the quality of the beef is lowered. Those losses are more than the cost of fertilizing the pastures. The fertilized pastures themselves carry enough more stock and produce a quality of beef enough better to compensate for the cost of improvements.

I am not friendly to heavy grain feeding but to continuous grain feeding from birth to slaughter. A fattening period, a stuffing period with fattening foods, means fat put on in layers between the muscles and on the ribs and exterior parts of the body in a bunchy way. A soft oleaginous touch is the result, plus an increased ratio of fat for waste. Where the steer is growing muscle and fat proportionately the fat is laid in among the fibres of the muscles, and the carcass where cut shows a marbled condition. To the touch the flesh is solid yet elastic in the live animal. When fed for

the ends mentioned the steer will bring more and will pass for the finished product at less weight than where crowded through a final fattening period under high pressure rations.

The Canadian Experiment Station, personal trials at our State experiment stations and trials with cows at State experiment stations have shown that high-pressure rations, while increasing the rate of growth, are accompanied by an increase of cost faster than the growth increases. The Vermont station when corn ensilage is fed finds that after passing 4 pounds of grain daily the cost of milk increases, beginning somewhere between this amount and 8 pounds of grain. With cows I do not find it advantageous to give more than 6 pounds of grain along with 25 to 35 pounds of silage. As the production of butter fat is fully as exacting as the production of flesh the same general truth applies equally to cows. Data so far secured corroborate this conclusion. However, as steers increase in quality they rise rapidly in value, and possibly warrant more strenuous feeding.

So far as informed I do not deem it advantageous to pass 8 pounds of grain daily unless for a short time at the finishing period. If grain is fed continuously from start to finish, during summer and winter, and gain is steady and continuous, heavy grain rations are not necessary.

I shall not enter into details of feeding, especially details of methods for the calf, as they are in familiar practice. The aim of this talk is to point out the broader problems of beef raising here. For the calf I would advise the use of a small amount of dried blood, as this material is a most valuable food, and especially so for calves, as it is easily digested and obviates scours, keeping calves in good healthy condition.

I have said nothing about balanced rations or the nutritive ratio, as, too, it is not my purpose to make the discussion exhaustive, nor will time permit. It was my fortune to conduct experiments on the line of German nutritive ratios some years before others entered the field. I am convinced that its importance is over-rated by extremists, and that the better class of feeders, even unaided, unconsciously give

protein enough, especially those who buy foods with reference to their fertilizing value to the farm. Rations whose coarse foods are made up of straws, timothy and silage, in which the ears are not nearly matured, must have protein grains accompanying them nearly to the full extent grain is fed unless fed in larger amounts than advised. But where the ration contains clover, oats and peas and other protein foods the ration can contain corn meal, the one carbonaceous grain food, in part. One observing these general distinctions will not err widely in his food ration so far as nutritive ratio is concerned.

The calf starts on skim-milk and protein foods, like linseed, oatmeal, middlings and gluten meals. The rise in grain from the first half pound is gradual, until at a few months old 3 to 4 pounds are given. The rise may follow gain of steer, and may, after 400 or 500 pounds are reached, fall below 1 per cent of live weight, dropping, as weight goes up, to two-thirds of 1 per cent if the aim is 1,300 to 1,500 pounds. It is better to have types that will sell under this extreme.

The protein foods increase the ratio of lean meat, but if fed alone will not give the desirable color of carcass that corn meal will. At the start the foods may be wholly the protein meals named, the kinds being determined by the markets, gradually being supplemented by corn meal. At the close of feeding corn meal may make to advantage half to two-thirds of the ration.

The feeds of all kinds must be palatable or fed with great skill. Palatableness is not necessarily nutritive in effect, but induces free consumption, the taking in of a goodly proportion of excess food. Foods vary in palatableness, and some unpalatable ones must at times be given. These may be fed at the time of day when appetite is best, and for the coarse foods in small amount, kept replenished and in fresh form so long as they are accepted. In a large ration its most palatable portions will be selected, and the balance breathed on and drooled over and finally rejected.

FEEDING LAND THROUGH STEERS.

Beef is but a factor of the general farm policy and must be controlled to the general good. The amount of beef made and the success of the farm as a whole are dependent upon the crops made. The purpose of the farm is to secure as much beef per acre and from as many of its acres as possible to press into full service. Hence, in the rotation formed regard will be had to the greatest total output of the acre though it may induce the growth of other rank growing annuals than corn and include oats, hay, Hungarian and other great yielding crops. In the purchase of concentrated foods it will include the richest protein foods as a source of nitrogen.

The following table shows the amount of protein of the prominent concentrated foods, the fat, the value of the several foods as direct manures and their estimated value after the steer has withdrawn from them what he can, after necessary wastage has done its work, allowing also for the one-sided character of the manure made and interest account against manure on account of the long time required to recover it in crops. The estimate is based on the value of nitrogen, phosphoric acid and potash bought at their rates in chemicals and not in the more costly form of mixed fertilizers. I believe that the excrement from foods given in the table will in right use be worth the sums estimated. As the manure will be over rich in nitrogen the minerals should be associated with the manure in use.

	Protein.	Fat.	Nitrogen.	Phosphoric Acid.	Potash.	Value of Fertilizer Constituents to Ton.	Value as Manure in Practice per Ton.
Cotton-seed meal,	44.8	9.8	6.78	1.46	2.81	$28 51	$12 61
Gluten, . .	36.8	2.6	5.05	.33	.05	-	9 07
Linseed meal, .	38.3	2.5	5.26	1.61	1.24	21 11	9 53
Bran, . . .	15 4	4.0	2.46	1.40	2.73	12 45	6 47
Middlings, . .	15.6	4.0	2.42	.37	.26	8 96	5 07
Oats, . . .	11.8	5.0	18.20	.62	.22	7 43	3 46
Corn, . . .	10.5	5.0	1.65	.59	.37	6 75	3 27
Clover, . .	12.3	3.3	5.50	1.30	4.60	9 07	4 50
Hay, . . .	5.9	2.5	1.26	.53	.90	5 99	2 73

The figures for fat in the foods are given, as fat burning gives forth about two and one-half times the heat units that the starch of foods does, and purchasers of foods should take this into consideration. The theoretical value of foods for manure given in the same table are taken from data given by Professor Armsby.

From the right-hand column it will be seen that the manurial values of foods are too markedly valuable to warrant neglect in buying. If the manure of cotton-seed meal is worth $9.88 in practice more than from corn meal in the residue left after feeding, it should be fed when the prices of the two feeds are less apart than now, and until the fattening period forces the use of corn meal to protect the color of the fat and the quality of the carcass. I have used cotton-seed meal with good and economical results as a fertilizer when its nitrogen sells for less than nitrogen in the form of chemicals.

The Cost of Beef.

An approximate estimate of the cost of growing 1,250 pounds of steer can be made from existing data. Careful calculations show that the manure of the purchased grains, if protein or rich in nitrogen, will pay rent of building and attendance or care of cattle, and more than do this if the attendant's time is fully occupied. The grains for a series of years will probably be secured for 1 cent a pound. The coarse foods may be rated at $10 per ton. Passing the details by months and roughly approximating the averages I estimate the 600-pound steer (the average growing weight of the one under consideration) to consume in the 700 days allotted for his growth, covering two winters, — with 4 pounds per day the first winter after October birth, 3 pounds to pasture during the first summer, 6 pounds per day the second winter and summer, — 3,350 pounds of grain, or .78 per cent of live weight daily. He will consume of hay, or coarse food in the equivalent of hay, 2 per cent of live weight daily, or 5,300 pounds, costing $26.50. Pasturing first year $4, and $6 the second year. No skim-milk is included, as grain and hay are included from the start in amounts fully

covering the cost of skim-milk. The total cost is $70, or 5.6 cents per pound live weight.

The type of steer in question is likely to remain worth more than this by several dollars. At 6½ cents live weight his value would be $81.25, his birth-rate being regarded as 50 pounds.

This question of cost may be presented from another stand-point and apart from difference in cost of pasturing as against barn. The number of pounds of food required to grow a steer to a given weight is not fully determined, but it is quite probable that it can be accomplished on 10 pounds or less of food for a pound of growth up to 1,300 pounds weight. This food at prices named, if composed of 30 per cent of concentrated foods, would cost $81.50. As the calf starts at 60 or more pounds live weight the cost per 100 pounds live weight would be $6.21. This would leave a margin of profit for a series of years, the present outlook continuing. At the present time the rates for the quality of beef under consideration are more than the estimates. As stated, the value of the manure will exceed cost of attendance provided the attendant's time is fully occupied in the care of the stock or in some productive business.

If the ration is made up of grains of equal parts of corn meal, bran and cotton-seed meal, and the coarse foods of corn ensilage, hay and clover, the manure resulting would be valued at $28.03 in actual practice. It would not cost over one-half this sum for the care of the steers. It will be a very conservative estimate to credit the steer with $10 of manure above cost of attendance.

I am aware that questions for debate are involved, and that in a sense little direct profit is shown. The business of farming in New England is that of crop growth, stock feeding being a method of acquiring the manure to feed the crops.

If the crops of the farm can be sold to the stock of the farm at a good profit on their production, or for $10 per ton for the coarse foods and market rates for concentrated foods, the transaction is satisfactory. The indications are that we can get more than $10 per ton for coarse foods in good beef steers and still pay for the work involved. It appears that

the steer is likely to pay as well as other stock, all the elements involved considered.

The New Jersey Experiment Station fed 30 cows for one year and received 3,031 quarts of milk per cow. The cows were fed 8 pounds of grain daily and 17.9 pounds of coarse food. The milk may be estimated as equivalent to 300 pounds of butter, and its average value in the districts where steers would be produced as 22½ cents per pound, or $67.50. The skim-milk will pay for making and selling the butter, leaving the milking to be deducted from the butter receipts. This would reduce the sum by $10, or down to $57.50. The 9,446 pounds of food fed by the station would make 944.6 pounds of steer. This added to birth weight would bring him up to 1,000 pounds. He would have to be sold at only 5¾ cents per pound live weight to pay the same returns as the cow. He will do better than this, or as well as butter at 25 cents a pound. In the long run we must expect butter to pay slightly better than beef, as the mass of men will not long be tied to the cow as rigidly as she requires without a distinct gain by it. We may expect beef to be as desirable a farm product as butter, all elements considered.

It may be safely stated that plant food can be produced by steer feeding cheaper than it can be bought in the form of fertilizers. Therefore it should be so produced as far as possible. But as we are on the eve of a great, a very great, expansion of our New England agriculture, all sources of available plant food must be commanded. Our necessities will demand a heavy use of chemicals, at least until our farms reach the economic limit of production. This limit is far off and now unknown. Certain it is that New England farms produce but a small fraction of the crops they are capable of.

Mr. E. W. Boise (of Blandford). In the Connecticut valley we have hundreds of acres of good pasture land if properly cared for. We formerly raised the finest stock on our hills. I have seen four-year olds weighing 40 hundred to the pair. To-day none of that stock hardly can be found. Giving all praise to the Guernsey and to the Jersey stock, I have claimed for quite a time that they are no stock for our

hills, and we must go back to the dual purpose stock. We made mention of the dual purpose stock at last year's winter meeting.

Mr. J. S. ANDERSON (of Shelburne). I have listened with a great deal of interest to what Professor Sanborn has said. He has given us many truths, and there is a great deal to the subject he has brought before us. It is one which should interest every one of us. I go back to the day, many years ago, when these hills were filled with good cattle. We had at that time only one breed of cattle, the Shorthorn. I can tell you something of the way we managed in those days. We had the dual purpose cow; we had some of the best of that cattle that could be found. We had heifers that produced in a single year over 500 pounds of butter, besides supporting a family of five persons with milk, butter and cream. We thought we would see what we could do in the line of feeding up stock for the New York market. We commenced with a pair of heifers and we fed them until they were four years old. These heifers weighed in New York 4,800 pounds, and they were even flesh all over, no lumps, and when you came to cut that meat you would find it well marbled. There was some stock that we purchased that made not only good beef but good milkers. I have followed this business for over fifty years, and I know what I am talking about. He tells you about the growth from one year to another. I will corroborate this. We bought a pair of calves at eleven months old that weighed 1,500 pounds; we paid $200 for them. That pair of calves as yearlings weighed 2,640 pounds. They were fed on little roots and pastured in the summer. The next fall as two-year olds they weighed 3,400 pounds; as three-year olds, 4,300 pounds; the next fall as four-year olds, 5,000 pounds. This is not all history; we have the same cattle to-day, the dual purpose cow. I would like to show Professor Sanborn stock that we raise in old Shelburne. I have seen the day when we purchased 40 pair, averaging 3,800 pounds to the pair, and mostly three to four year olds. Last spring I turned a pair into pasture; they weighed 2,650 pounds, and when I took them down to the fair they weighed 3,210 pounds. That is what they

gained in that old pasture. Our pastures are rough and rugged, up and down, hills and holes.

QUESTION. How would you fertilize pastures?

Professor SANBORN. I would apply in the spring at first 300 to 400 pounds of phosphate and then each year a modest amount of nitrate of soda, the first time 100 pounds or more and then but little. Our soils are generally rich in potash, but I would put on a little.

Mr. G. H. ELLIS (of West Newton). Do you find it more profitable to grow milk and butter in your locality, or beef?

Professor SANBORN. As I am situated I think it is better and more profitable for me to sell milk.

Mr. ELLIS. You use a Shorthorn cow, do you, for your purpose?

Professor SANBORN. I began wrong by buying the best cows I could find in my neighborhood. Now I am coming to breed my own. I use the Holstein and occasionally Shorthorn to keep up the quality of milk to the Massachusetts standard. I mix the milk. Your law requires 3.7 per cent fat, mine reaches 4.

QUESTION. Would you keep any different kind of stock for furnishing cream for the creamery than for furnishing milk for Boston? My experience is to grow calves and feed them from five months to a year old, and then turn the cream into the creamery; that is the best paying thing in the dairy business I know of.

Professor SANBORN. I certainly should. I should not use the same cow.

Dr. J. B. LINDSEY (of Amherst). We had some experience at the experiment station ten years ago in growing beef. It was not particularly encouraging. One thing that impressed me was this: that the steers that were obtained made, comparatively speaking, a very poor growth. They were bought, perhaps in the immediate neighborhood, when they were 500 or 600 pounds in weight, and kept until they weighed 1,200 to 1,500 pounds. We found these steers only made about 1¼ pounds live weight each day. I thought that small, and one of the points I made in writing up those

experiments was that if we were going to grow beef in the future, as some in New England might find it profitable to do, we must have a better class of steers; and Professor Sanborn has well made that point. The average steer that we find is something like the average cow, — a pretty poor type. Another point, — at the time of our experiments beef was selling at a very low price.

I think we bought these steers at 3¼ or 3½ cents per pound live weight, and when ready to go to market we did not get more than 4. So of course we did not make any money out of it. But if beef is going to keep up in price I think there is a great deal of encouragement for those who are in the immediate vicinity of markets to produce beef at a profit. And those who are in the immediate vicinity of large markets in New England where there is such a demand for milk and cream will have a tendency to produce those articles rather than beef. I do not suppose there is any cow especially adapted to all purposes. My friend from Shelburne of course is a very enthusiastic Shorthorn man. I suppose Mr. Ellis is an enthusiastic Jersey man. I think it all depends upon what we are going to do. I don't think it would pay Mr. Ellis to have Shorthorn cows; he wants to produce a certain product, and in all probability the Jersey would be the more satisfactory; while perhaps a person way back on the hills, and farming in a little different way, might find it advantageous to select Shorthorns. I think the whole tendency is to specialize, to select the dairy type of animal for the production of milk and cream, and Shorthorns for the production of beef.

Prof. F. S. Cooley (of Amherst). Lest you think I am a partisan against the Shorthorn, I would say that the Shorthorn, I believe, is one of the best in its place of any cattle we have. We had a collection of cows come into our neighborhood a short time ago, and the poorest individual in the whole bunch was a registered Shorthorn, poorest in point of flesh. I have very frequently observed the same thing in highly bred cattle of this or another beef breed coming in from a poor pasture. Obviously, then, the place for a highly bred meat-producing animal is not in our poor

pastures. In other words, a high-bred Shorthorn is not as well qualified to grub her living, or his living, and make beef on a large range of poor feed as some other animals; and I think Professor Sanborn has struck the right idea in saying the pastures must be improved for the production of that type. More than that, I firmly believe that he is right regarding supplementary feeding during pasture season. I wish to ask him if he feeds any ruffage, anything but grain?

Professor SANBORN. No, sir.

Professor COOLEY. Which system, in your judgment, would produce the greater profit, the stocking of your pastures with beef cattle heavily, so you require a good deal of supplementary feed, or stocking them a little below what they would carry and not feeding so much of the supplementary feed?

Professor SANBORN. It would depend on location. I like the English system.

QUESTION. Will you please tell us in regard to use of ensilage in beef production?

Professor SANBORN. It is first-class for beef production.

Mr. A. A. SMITH (of Colrain). I can see that there has been a great deal of interest in this question. I have been interested in it myself, but I am surprised at what Professor Sanborn has said about the stock which we shall use for beef purposes. I was really in hopes that he would take for his text, "The Shorthorn," and stick to it. We have felt that the registered Shorthorns were the typical animals of New England.

Secretary STOCKWELL. I have been much interested in this morning's session; but it brings to all our minds that the delegate of the Board who invited us here, and through whose importunities we came here, is not with us, has not been with us and cannot be with us during the meetings. In the early summer his health began to decline. To-day he is too ill to take note of what we are doing; therefore, I would move that President Goodell and Mr. Brewster be a committee to draft resolutions of sympathy.

The motion was carried. The committee appointed reported the following resolutions, which were adopted: —

Whereas, The sad intelligence has come to us that our esteemed associate and colleague, George P. Carpenter of North Adams, has been stricken with severe sickness, and thus deprived of the privilege of meeting with us at this session of the State Board, which he has helped so much to secure and anticipated with so much interest and enthusiasm, be it

Resolved, That we hereby tender to him our sincere sympathy in his trial and sickness, and our regrets that he is not able to give us his genial presence and inspiration, and express our hearty hopes that he may be speedily restored to health and strength, and to his accustomed place among his fellow citizens.

Resolved, That a copy of these resolutions be transmitted to our friend, and pass into the records of this meeting.

Afternoon Session.

The meeting was called to order at 2 o'clock by First Vice-President Sessions, who said: We have with us to-day a man who is somewhat new to us, although of great experience in his line, thoroughly educated, having made it his business to put in practice his theories. I take pleasure in introducing to you Prof. F. A. Waugh, professor of horticulture in the Massachusetts Agricultural College, who will speak on "Our Agricultural Advance."

OUR AGRICULTURAL ADVANCE.

BY PROF. F. A. WAUGH OF AMHERST.

The title which has been given to this address is not very accurately suggestive of the matter which I propose to present. I have been unable to select a more appropriate one, however, and so I shall have to beg your charity on this point. The mere item of a title may be overlooked, perhaps, providing the discussion should prove to be of interest. My real object in the construction of this lecture was in fact threefold: (1) to examine some recent agricultural statistics, particularly those of the twelfth census; (2) to call attention to certain of the more striking general tendencies in American agriculture which they suggest; and (3), with these figures and tendencies in view, to show the important influence which our horticultural industries have on our agricultural progress as a whole.

The statistics given below are, in all cases, from the twelfth census of the United States, — that is, the census for 1900, — unless otherwise specified.

Area of Farms.

Let us look first at the size of the average farm in the United States. The figures for three decades are as follows: —

1880,	133.7 acres.
1890,	136 5 acres.
1900,	146.6 acres.

These are the averages for the entire United States. It will be seen that the size of the average farm has been steadily increasing. This would suggest at once that farming is being done on a larger scale, with greater capital,

etc. We have always thought that the progress of the rural life in America was in the direction of the segregation of farms, — from larger farms to smaller ones. We have thought that this was necessarily correlated with our advancement toward a more intensive agriculture. From these figures, however, we would infer that our agricultural evolution was moving in the other direction, namely, toward a more extensive rather than a more intensive practice.

When we analyze the figures, we shall find that both things are true. The fact is, that the average size of farms has increased in the western States, while it has decreased or remained stationary in the eastern States. This fact is brought out in the following figures, showing the average number of acres to each farm by geographic divisions by decades: —

	1880.	1890.	1900.
United States,	134	137	147
North Atlantic States,	98	95	97
South Atlantic States,	157	134	108
North Central States.	122	133	145
South Central States,	151	144	155
Western States,	313	324	386
Massachusetts,	87	87	83

While the decreasing size of eastern farms is less well marked than the increasing size of western and southwestern farms, it is nevertheless fairly well established. This tendency toward smaller farms has been clearly manifest in Massachusetts during the last decade.

The sum of the matter, then, is this: we may say, on the basis of these figures, that we are moving slowly toward a more intensive agriculture in the eastern States, while the west is moving distinctly toward a more extensive practice.

There are some other evidences, however, to be taken into consideration, and these we will examine presently; meanwhile, our final judgment on this point may be fairly reserved.

Ownership of Farms.

The ownership of farms has, theoretically at least, a somewhat close connection with the average size of farms. We will next examine, therefore, the statistics of farm proprietorship. We find that in 1880 75 per cent of the farms in the United States were operated by owners, in 1890 this proportion had been reduced to 72 per cent, while in 1900 it has been still further reduced to 65 per cent. The fall of 7 per cent in the last decade is especially striking.

In the North Atlantic States the proportion of farms operated by owners as compared with those operated by tenants is constantly higher than in the United States at large. In 1880 it was 84 per cent; in 1890, 82 per cent; and in 1900 it was 79 per cent. These figures, along with similar figures for the Commonwealth of Massachusetts, may be compared more easily when arranged in the following table: —

	United States.	North Atlantic States.	State of Massachusetts.
1880,	74.5	84.0	91.8
1890,	71.6	81.6	90.7
1900,	64.7	79.2	90.4

We cannot but be struck with the decreasing proportion of farm owners among farm operators. This means, of course, a corresponding increase of tenant farmers. This tendency is indisputable in the country at large, and there is hardly a State in the Union which offers an exception. We may congratulate ourselves that this tendency is reduced to a minimum in our own Commonwealth, but even here it has not been altogether suppressed.

The exact meaning of these figures may fairly be ques-

tioned. The pessimistic man might jump at the conclusion that we were tending inevitably toward European conditions, — toward the establishment of a gentry of land owners and a peasant tenantry of land tillers. It is doubtless true that in many respects we are gradually approaching European conditions, not only in agriculture, but in our general industrial environment. Nevertheless, the suggested inference from the figures is premature. It would probably be a better statement of the facts to say that our agriculture, like our other industries, is advancing, through the aid of capital invested by those who, from the nature of the case, cannot be operators. The figures do not necessarily mean that the farms of the United States have been gradually slipping out of the hands of the men who used to own them. In fact, the absolute number of owners operating farms has steadily increased.* The number of farms operated by tenants has simply increased more rapidly. This may mean, and probably does mean, that an increasing number of persons have felt justified in buying farms as an investment, just as they have always bought railroads, water works and manufacturing industries.

The distribution of these investments suggests that farms have not been for sale in Massachusetts, or that prices have been unattractively high, or that, for some other reason, capital has preferred to seek the western farms. Doubtless a certain number of western farms have been taken up on mortgage foreclosures, and capital has thus found a forced investment in farm lands.

Looked at in any light, however, the figures indicate a specific change in agricultural conditions. This change is in the direction of the investment of more outside capital; and this means, in agriculture as in every other industry, that an economic advance is being made.

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* The number of farms operated by owners in the United States stands as follows: —

1880,	2,984,306
1890,	3,269,728
1900,	3,713,371

Improved and Unimproved Farm Lands.

Another matter which it will be interesting to notice in this connection is the disproportionate increase of unimproved farm land. Expressed in percentages of the total area of farm land, the figures for the United States are as follows: —

1880,	53.1 per cent improved.
1890,	57.4 per cent improved.
1900,	49.3 per cent improved.

The falling off of 8 per cent in the last decade is especially remarkable. In the State of Massachusetts the figures are still more striking. They follow herewith: —

1880,	63.4
1890,	55.3
1900,	41.1

In the case of Massachusetts there has been an absolute, as well as a proportionate, decrease, as is shown by the following figures: —

1880,	2,128,311 acres improved farm land.
1890,	1,657,024 acres improved farm land.
1900,	1,292,132 acres improved farm land.

Without going any further, it might be assumed that this decreased acreage of cultivated land indicates a more intensive cultivation on the remaining acres. This possibility deepens into a certainty when we study the —

Value of Farm Products.

The total values of farm products (reckoned for the year preceding the census year) for the United States and for Massachusetts for three particular years are shown herewith: —

	United States.	Massachusetts.
1880,	$2,212,540,927	$24,160,881
1890,	2,460,107,454	28,072,500
1900,	4,739,118,752	42,298,274

Even at a glance the increase in the value of farm products is surprising. When examined in comparison with the figures given a moment ago, this increase is truly remarkable. Thus, while the absolute acreage of improved farm land in the United States has increased 15 per cent during the last decade, the annual value of farm products has increased 92 per cent. That is the record for the United States at large. In the Commonwealth of Massachusetts, with 22 per cent *less* land under cultivation, the annual value of farm products has been *increased* 51 per cent. That looks like an improvement in agriculture, does it not? I doubt if any other industry in the world can show a similar advance.

These figures show, furthermore, that, while there may be some tendency in certain sections toward the development of agriculture along lines of more extensive farming, the great forward movement of the time is most emphatically in the direction of more intensive farming.

The Ratio of Productiveness.

The efficiency of intensive agriculture may be shown on another side by another draft of statistics from the twelfth census. It has been necessary to compute the following figures from data given in the census report, and, since averages are used in the computations, the results may not be accurate to a cent. The general principle is so emphatically brought out, however, that the difference of a few cents here or there is not material. The following table shows the rate of gross income to each acre of farm land for farms of different sizes. The figures are for the entire United States.

AREA OF FARMS.	Income per Acre.
500 to 1,000 acres,	$2 55
260 to 499 acres,	3 56
175 to 259 acres,	4 85
100 to 174 acres,	5 26
50 to 99 acres,	6 71
20 to 49 acres,	9 26
10 to 19 acres,	15 73
3 to 9 acres,	33 83
Under 3 acres,	296 00

The rapid and regular increase in productiveness as the farms grow smaller is too striking to be disregarded or denied. We should easily be justified in founding upon such data the law of productivity, which might be formulated as follows: the productivity of farm land is inversely proportional to the size of the farm. It may be seen that this law is almost mathematically and exactly correct, according to the foregoing figures.

Statistics of Population.

Before leaving this part of the subject, I must ask the privilege of a slight digression, in order to speak of the statistics of population and their relation to the business of farming. The population of the United States in 1900 was reported to be a trifle over 76,000,000, nearly 3,000,000 of which belonged to the Commonwealth of Massachusetts. Now, something more than 37 per cent of this 76,000,000 men and women live in cities, and this percentage is steadily increasing. In Massachusetts almost 87 per cent of the entire population belongs to the cities, and this proportion is also rapidly increasing. This will be seen at a glance by comparing the figures for twenty years. Herewith are given the percentages of urban population, computed on the basis of total population: —

	United States.	Massachusetts.
1880,	25.8	65.9
1890,	32.9	83.0
1900,	37.3	86.9

Thus, while there was, in 1880, one city customer to each three farmers (counting the entire rural population as farmers), there are now just twice as many, or one city customer to each farmer and a half. Or, taking the figures for Massachusetts, each farmer has 6.7 city customers now, against 1.9 customers in 1880. In other words, the farmer's city market in Massachusetts has been increased three and one-half times in twenty years.

Localization of Special Agricultural Industries.

The advancement of other industries is marked not only by increased capitalization and productiveness, but by greater specialization and by more and more localization. The furniture business has developed especially at Grand Rapids, the iron business at Pittsburg, meat slaughtering and packing at Chicago, wheat marketing at Duluth, while Pabst and Schlitz have literally "made Milwaukee famous." In Boston the book dealers are most numerous in School Street and Cornhill, the railroad offices are clustered on upper Washington Street, the department stores are further down, while the stationers are between Devonshire and Federal streets. Is this principle of localization illustrated also in agricultural pursuits?

Certainly it did not use to be. Every farm in former times grew its own grain, vegetables and fruit; raised its own eggs, pork, beef, mutton and wool; made its own butter, soap, candles, yarn and cloth; and provided for practically all the wants of the family. One farm might be specially suited to the dairy business, and highly unsuited to the raising of fruit and vegetables: yet the owner felt unable to take up dairying, and discard apples, potatoes

and onions. Such a system is evidently very crude and primitive, when compared with a specialized system of farming, in which each farm or each locality produces those crops which can be grown to greatest advantage.

It requires no elaborate argument to show that we have developed certain specialties to some extent. Cape Cod is famous for its cranberries and the Connecticut valley for its tobacco growing. But, since I have been following the statistical line thus far, I will add a few figures to illustrate this principle of localization.

For this illustration we may very properly select the county of Suffolk, Commonwealth of Massachusetts, where, as some folks believe, the highest degree of specialization, refinement and advancement known anywhere in the world exists. Now, in the city of Boston, where the agricultural products in 1895 amounted to $615,562,* the greenhouse business predominates, furnishing 48 per cent, or nearly one-half, of the entire amount. In the city of Chelsea, greenhouse products still lead, to the extent of 52 per cent of the whole amount. In the town of Revere, however, 72 per cent of the produce was vegetables in 1895. In the town of Winthrop, dairy products led the list, to the extent of 30 per cent of the whole. By selecting individual towns in different parts of the State, still more striking cases of localization can be found; but the figures already given serve to bring out the point. There can be no doubt but that agriculture is advancing rapidly in this respect also.

Special Lines of Development.

The next point which I wish to bring out is not so well illustrated by the statistics of the Census Bureau. There are many things about any census which are hard to understand; and one of the hardest of them is, why such different subjects should be covered, and why the treatment should be so diverse from one decennial period to another. There are many interesting data in each census report which would be ten times as valuable as they are could they be

* Census of Massachusetts, 1895, p. 281. Bureau of Statistics of Labor, Boston, 1899.

brought into any sort of comparison with the data of earlier or later reports. Let us hope that the new permanent Census Bureau will do more consecutive work, and that we shall be able to follow matters out to more definite conclusions hereafter.

What I would like to illustrate now, is the unequal development of different lines of agriculture. Of course we all know in a general way that the aspects of our agriculture are rapidly changing, and that the crops which were most prominent fifty years ago are not necessarily of the same relative importance now. We all know that some branches of agriculture have developed more rapidly than others. But we have hardly suspected how great are these inequalities, nor how rapid are some of the changes. Still less do we usually think that these changes follow any general law. Nevertheless, I believe these changes could all be illustrated and the general law established if only we had statistics just a little more complete, consecutive and coherent.

Merely as a sketch of my notion of the situation, I will present the following figures, selected almost at random from the census report. They show the rate of development in certain specified lines of agricultural industry in the United States during the last decade.

UNITED STATES.	1890. Total, in Millions.	1900. Total, in Millions.	Per Cent Increase.
Number of milch cows, ...	16½	17	3
Number of horses, ...	15	17	13
Acres of hay and forage, ...	53	62	17
Acres of cereals, ...	140	185	32
Number of apple trees, ...	120	202	68
Number of peach trees, ...	54	100	85
Number of plum trees, ...	7	31	342
All fruit trees, ...	193	367	90

The comparatively small increase in the number of milch cows is remarkable and suspicious. It suggests an error somewhere. An increase of 13 per cent, however, in the number of horses within ten years is not so bad for this "horseless age."

As soon as we come to such specialties as fruit, the rate of increase rises in a most striking manner. The total number of fruit trees has increased 90 per cent, or almost three times as fast as the acreage of cereal crops, and five to twenty times as fast as the area of other general farm crops. The more special fruit crops — those most difficult of cultivation and most uncertain of a market — have developed more rapidly than the more staple fruit crops. Thus, against an increase of 68 per cent in the plantings of apple trees, we may match an increase of 85 per cent in peach trees and 342 per cent in plum trees.

These meagre figures suggest the general law. The cultivation of the staple field crops has been extended comparatively slowly, while the cultivation of special or difficult crops, or those which yield merely the luxuries of life, has been extended much more rapidly. In fact, the rate of development seems to stand in direct proportion to the degree of specialization or refinement represented in a given crop. There are doubtless some exceptions to this rule, but I believe they are such as may be safely rated as distinct exceptions; perhaps they may be overlooked altogether.

In order to illustrate once more this law of unequal development, and at the same time to apply it to a case in which we are particularly interested, I will give a few statistics from Massachusetts. These are taken from the census of Massachusetts for 1895.* The first table shows the percentages of increase in various classes of agricultural property in the State for ten years, 1885–95.

Agricultural Property.	Per Cent Increase in Ten Years.
Total farm property,	1.72
Land,	— 0.39
Machinery, implements, etc.,	9.87
Buildings,	4.71
Domestic animals,	— 12.90
Fruit trees and vines,	19.02

* Census of Massachusetts, 1895, pp. 331–333. Massachusetts Bureau Statistics of Labor, Boston, 1899. Quoted by Waugh, Fruit Harvesting, p. 3. New York, 1901.

These figures indicate that, while land has slightly decreased in value, there has been a substantial increase in buildings, machinery, implements and all the equipment convenient to a more advanced, more intensive, more specialized and more refined system of farming.

The general principle which we have in view is even more clearly brought out when we consider the increase (or decrease) in the value of various agricultural products in Massachusetts during ten years. Taking the same period as before, namely, from 1885 to 1895, we have these figures: —

Agricultural Products.	Per Cent Increase in Ten Years.
Total products,	10.73
Dairy products,	24.11
Hay, straw and fodder,	7.39
Cereals,	— 40.46
Fruits and berries,	6.33
Vegetables,	22.24
Hothouse and hotbed products,	31.42
Greenhouse products,	153.92

These figures are almost self-explanatory, in the light of the foregoing discussion. The figures for fruits and berries are disappointingly low, but that is merely a local exception.

The two groups of statistics just given in exemplification of the law of unequal development are both very partial, and therefore in some degree subject to error. It will be more convincing to turn to another statistical comparison from an altogether different source, and covering a much wider range of time. These figures were originally compiled by Pres. George T. Fairchild for his "Rural Wealth and Welfare,"* which is the standard work of the time on rural economics.

These figures show the increase in population compared with the increase in the total production of the staple agricultural crops in the United States during the period between 1850 and 1897, — almost half a century. These figures are as accurate and reliable as statistics can ever be.

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* Fairchild, Rural Wealth and Welfare, p. 11. New York, 1900.

Population and Products.	Per Cent Increase.
Population,	270
Rice,	60
Sugar,	191
Sweet potatoes,	112
Buckwheat,	163
Rye,	198
Tobacco,	313
Butter,	323
Potatoes,	331
Cotton,	355
Corn,	357
Hay,	376
Wheat,	465
Oats,	551
Barley,	1,506
Fruits,	2,000

These figures indicate that, while the staple crops have increased only slightly faster than population, fruits — the only intensive specialty in the list, with the possible exception of butter — have increased at the enormous ratio of 2,000 per cent.

Summary of Arguments.

In closing this too statistical, and therefore dreary, lecture, it will be best to recapitulate the facts presented, placing them under their several heads. They may be classified and summarized as follows: —

1. *Area of Farms.* — It is shown that the average area of farms has increased slightly in the United States during the last twenty years, the increase amounting to about 10 per cent. In Massachusetts, however, the average farm area has remained about stationary.

2. *Ownership of Farms.* — There has been a steady decrease in the proportion of farms operated by owners in the United States. This decrease, though still well marked in Massachusetts, has been considerably less than in the country at large. This change in the proportion of owners operating farms has occurred, apparently, not by former owners losing their farms, but by the purchase of farms as investments by people who could not operate them. This

point, however, cannot be demonstrated, and should not be insisted on too strongly.

In both these matters, *i.e.*, area of farms and ownership, our American agriculture seems to have been moving toward a more extensive practice. This view, however, is not supported by other data now to be cited.

3. *Improved and Unimproved Farm Land.* — The proportion of unimproved land as compared with improved land has been steadily increasing in the United States. In Massachusetts the amount of improved farm land is not only relatively but absolutely less than it was twenty years ago, the amount having fallen in that time from a little over 2,000,000 acres to a little over 1,000,000.

4. *Value of Farm Products.* — In spite of the reduction in the proportion of improved farm lands, agricultural production has enormously increased. During the last decade the value of agricultural products has increased 92 per cent in the United States, and that with an increase of only 15 per cent in the amount of cultivated land. In Massachusetts the increased production has amounted to 51 per cent, with an absolute decrease of 22 per cent in the amount of land under cultivation.

5. *Productiveness.* — The efficiency of intensive cultivation may be yet more clearly shown by the comparative productiveness of small farms. Statistics for the United States show that the productivity of farm land is inversely proportional to the size of the farms. This formula may be called the law of productivity.

6. *Population.* — The population of the country has increased rapidly during the last twenty years, but this increase has been much more rapid in the cities than in the rural districts. Massachusetts now has 87 per cent of the total population of the State resident in cities, — an increase of 21 per cent in twenty years. This means a marked enlargement of the farmer's market; in fact, taking Massachusetts alone, the farmer's market in twenty years has been multiplied by three and one-half.

7. *Localization.* — It is easily shown that our American agriculture exhibits this further mark of progress, — that

the production of special crops is becoming more and more localized. This is a practical advantage, in that it utilizes special soils and exposures for the crops best suited to them; and it is a commercial advantage, in that it helps to consolidate the business of handling, transporting and selling the crop.

8. *Specialization and Unequal Development.* — It can be shown that our agricultural industries have been greatly specialized during recent years; and it appears, furthermore, that the various specific branches of agriculture have developed with marked inequality, whether we consider the country as a whole, or one State, county or town at a time. The law which seems to govern this inequality of development is this: the rate of development in each branch of agriculture is proportional to the degree of specialization, refinement or intensiveness of the practice involved.

General Plea.

In conclusion, I wish to draw a moral and to present a plea. It is evident that our national system of agriculture is moving forward with a certainty and a rapidity that are truly astonishing. In this movement, as in every other beneficent revolution in America, past or present, the Commonwealth of Massachusetts bears an honorable part. It is plain, further, that our present progress in agriculture is favored by the same factors which have brought about such wonderful improvements in other industries, viz., by concentration, intensification of effort, by localization and by specialization. One of the most marked and characteristic phases of this specialization, however, has been the unequal development of different branches of agricultural industry. Those branches which have led are the ones which are most refined in their methods, — most intensive in their practice.

The moral is, that, if we seek the advancement of agriculture, we must encourage the intensive branches. This is particularly applicable to the State of Massachusetts and to other States similarly situated. Though the big undertakings in agriculture — the extensive operations — are always sure to seize upon our attention and to divert

our interest, yet we know that our salvation lies in the other direction.

My plea is for the horticultural branches. I ask for them a juster recognition at the hands of men who are interested merely in the success of agriculture in general. There are thousands of farmers who have not yet become marked as specialists. They are engaged in so-called general farming. To them an acre of buckwheat is just as good as an acre of American Beauty roses or an acre of chickens or an acre of Jersey cows, if only they can make a dollar from it. What I mean is, that they are not prejudiced in favor of any specialty, and they see no advantage in one above another. There are many other men in other circumstances who have a genuine general interest in agriculture, without caring for one branch above another. All such men are apt to rate the value of a given branch according to the net income which it yields. If there are more dollars invested in corn and hogs than in apples and lettuce, then corn and hogs get their vote for first place.

But we have shown that many of these cruder branches of agriculture are rapidly waning in Massachusetts, while the more refined branches are still more rapidly gaining: and we have also shown, what is yet more important, that the more refined branches are necessarily the leaders and teachers of progress. Where are the battles of intensive agriculture fought? Where are the delicate, the critical, the vital problems solved? In the orchard, the garden and the greenhouse. It needs no demonstration to convince the most skeptical person that the most intensive agriculture of the world is that of the man who grows lettuce or roses under glass, or of the man who grows celery and strawberries out of doors. That man is necessarily the leader in all our agricultural progress. Let us accord to him the recognition and the praise which his works merit.

Professor SANBORN. Are not extensive and intensive agriculture consistent with each other? Your figures seem to show there is some inconsistency.

Professor WAUGH. No, sir; it is possible in individual

cases to have intensive and extensive farming, to buy more land and farm it better; but, as a general rule, all men included, the two things are mutually exclusive. Farming has been made more extensive and more intensive, but the development in any one case has been in one way or the other.

Professor SANBORN. Isn't the tendency of the age to be more extensive and intensive in every domain of life?

Professor WAUGH. Yes, and no. We have more extensive agriculture in the western States, more wide-spread farming: and in other localities we find more intensive farming.

Mr. JAMES DRAPER (of Worcester). In your judgment, with the transportation facilities, do you believe there is encouragement for the farmer to plant orchards in Massachusetts?

Professor WAUGH. I don't know. I should hate to confine myself to orchards. The general development of the situation has very much in favor of the fruit-growing industry here. Massachusetts is supplied with early fruit from the Southern States, — Maryland and Virginia, where the San José scale is twice as bad as here. People grow strawberries, ship them to New York City, reload them and ship to Boston, pay for refrigerator car, transportation rates, and sell strawberries from western New York in the Massachusetts strawberry season. It seems to me that that is a bad industrial situation. There must be a very wide margin to do this. Massachusetts properly leads the United States in the proportion of city residents to total population. It has the largest farm market. That is the most important reason why there should be developed here those specialties which are delicate and perishable, while corn, etc., may be brought from the west. Strawberries, Easter lilies, etc., should be raised here on the ground, in order to get much profit.

Mr. DRAPER. I notice by statistics that the greatest rate of percentage of gain of any fruit was the plum. The question is, whether the plum of any variety can be grown and handled profitably. My experience has been that it is very

difficult to handle them in the market. Whether you consider there are varieties of the plum, and methods of their production, so they can be grown and marketed here in Massachusetts to a profit?

Professor WAUGH. There is no doubt about it, — not the slightest. There are people who do do it; and it seems to me that if there are people who do it, that is the best answer to your question. Your question is this: "Can plums be grown and have a profit here in Massachusetts?" I say yes, sir.

The CHAIR. What is the future of apple growing in Massachusetts?

Professor WAUGH. There is a great future in it, if it is improved. I am sorry to say that what I have seen of apple growing here is behind the times. The people in the neighboring States are considerably ahead of those in Massachusetts in growing apples, especially in Maine, New Hampshire and Vermont. They have better methods, raise more fruit on a given number of trees, buyers pay them better prices. The methods in use in the Massachusetts orchards are not what they ought to be. I should say there is very particular need for the extension of the apple business in Massachusetts, but that the greatest need is not to make it more extensive, but more intensive.

The CHAIR. Kindly give us a few points in which intensiveness is to be increased, — particular work all along the line, is it?

Professor WAUGH. In a way, yes, sir. I cannot give it briefly very well. I should say better cultivation is needed, better treatment of the soil. The majority of orchards are not cultivated at all. If I were going into the apple business, I would like others to grow their apples in the grass, and keep up that practice; because certainly it is the experience of everybody that much of the profit is made by giving good cultivation and good feeding, and that means good spraying and pruning. There is one thing which strikes me more particularly in the line of argument I have been trying to follow to-day, and which I think should be mentioned. The apple needs to be more specialized here in

Massachusetts. Here in Massachusetts 65 per cent of all apple trees are Baldwins. I should not plant Baldwins at all, because everybody else has. If there is any place in the world where apples can be sold, it is in Massachusetts.

The CHAIR. I wish our old friend, Mr. E. W. Wood of West Newton, would tell his story about setting out an orchard with apple trees.

Mr. WOOD. I believe in growing for the market we want to grow what the community wants, and there is no apple to-day that stands as well in our market, and no apple that is better if as good for export, as the Baldwin apple. President H—— proposed to set out an orchard of 600 trees, and he went to inquire of a fruit house in the city that does the largest fruit business concerning what variety of tree he had better set out. Meeting one of the firm, he said: "Mr. Curtis, I propose to set out 600 apple trees. I would like to have you tell me what variety I shall buy." "What do you want them for, — for the market?" "Yes," he replied. After thinking a minute, Mr. Curtis said: "Put out 500 Baldwins." "Very well, what shall the other 100 be?" he asked. "Well," he said, "do you mean them for an entirely commercial enterprise?" "Yes," was the reply: "I have planted all my trees for my home consumption, and these are to sell." "Put out the other 100 Baldwins," said Mr. Curtis. That was after forty years' experience in the wholesale fruit business, in the largest concern in the city of Boston.

The foreign market is one that our people should look to. It is increasing every year in its demand, and the facilities for shipping have improved through our cold storage methods.

This year has been a most fruitful year, and apples have been bringing $1.75 per barrel at the depot in New Hampshire. Is there any other product that the New England man can grow out of the ground with as little expenditure for cultivation and fertilizer that is paying the profit that apples will at $1.75 a barrel?

I am sorry not to see more young men in this audience; those are the men we want to meet. If I were a young man

to-day, and proposed to get my living out of the soil, I would start with apple culture, and increase it as far as I could in doing well. I believe there is money in it, and the safest investment that any young man can make.

The CHAIR. I want to tell a little incident. Some ten years ago in Wilbraham they proposed to hold a farmers' institute, and it was voted to send them a speaker on fruit. I sent our friend who just took his seat, and they had a good meeting, and the good seed seemed to take root. Next year they wanted another, and I don't know but Mr. Wood went that time; and the third year they sent a request for Mr. Hale, the great peach grower. And the result of those three institutes was that more than 20,000 baskets of peaches were shipped from a distance within a mile of where the institute was held. I would like to have Professor Waugh tell about peach culture.

Professor WAUGH. I believe that the prospect in peach culture is better, perhaps, than the apple. Those fruits that require special knowledge and that are a greater luxury always bring greater reward, and in the United States there has been much attention given to peach culture. The increase in twenty years is 68 per cent in apples and 85 per cent increase in peaches. Whether in profits or not, I could not say, but evidently it is so. Men who have understood the production of peaches have made money, have demonstrated that money can be made in peaches at a good profit. One consideration that should be borne in mind in the apple business and peach business is, that they can be carried on on land comparatively worthless. I have been looking around, and I have seen land that can be had at $2.50 to $5 per acre suitable for peaches or other fruits.

Mr. WOOD. This has brought me to state some things I have seen in Massachusetts the present year in the way of raising fruit. I am always pleased when I can find and investigate an agricultural industry that is a success. It is worth a farmer's while to go to some good farmer's establishment and learn how he does things. I am not engaged in the fruit business myself, but I have a friend who is. He invited me this fall to his orchard of peaches, and his

establishment was one of the finest illustrations I have ever seen of successful farming along the fruit line. Twenty-five years ago he bought for a nominal sum 25 acres of land; he planted upon it 2,200 apple trees, and a part of it he planted with peaches instead of apples. I had a letter from him the other day saying he had completed the harvest of his apples, and had 2,800 barrels, and only a part of his trees bore. He has so trained that orchard by cultivation that a part bears one year and the other portion the succeeding year; and what Professor Waugh said in regard to cultivation I saw illustrated there. All that 25 acres is cultivated as carefully as a dairyman cultivates his farm. It strikes me there is a field here, especially in New England.

Mr. Draper. My friend is a Baldwinsonian from the sole of his feet to his scalp. But I believe there are other apples fully as good; for instance, the Sutton Beauty. This apple bears quite regularly; it is a red apple, — brilliant red. Let us take something that is a little different from the Baldwin and every way as good, and will demand better prices. While the Baldwin will sell from $1.50 to $1.75, this apple will bring $3 to $3.50. We have with us a gentleman who has been quite successful in raising apples, — Mr. Richardson of West Brookfield. I wish you would call him out.

Mr. Richardson. I did not expect to take any part in this afternoon session. I have had a little experience in selling my own apples. My neighbors have thought it best to ship theirs to the same market. In regard to different varieties of apples, and especially Massachusetts apples, I would call to mind the statement made by one of the largest wholesale dealers in Boston, that, whereas Massachusetts Baldwins were selling at $2.50, he had some choice Maine apples selling as high as $3.25. Apples did not quote $3.25 in Massachusetts, because it is not possible for a Massachusetts apple to bring that price in our market. Why this is so I don't know. We do find a great variety of apples upon our Massachusetts market, and we find that our export trade is increasing rapidly. It calls for red apples, — not necessarily for the largest apple, but fair, firm and well-put-up

fruit. This quality of fruit demands a good price, even in a year like this. We are also aware to-day that the King apple and Spitzenburg are bringing good prices in our own market. I heard a wholesale dealer state that the Spitzenburg brought a price ahead of any other apple in Massachusetts. How true this is, I do not know. I do know that our returns from the King apple were $2.50 per barrel. A week ago Saturday what the return was from 1,200 barrels of Baldwins that we sent into market I cannot say; but we do know that good Baldwins are bringing $2.50 for A-1 stock. I was a little surprised this morning, in calling upon a market in Springfield, to find the price of Greenings was $2.50 per barrel. I saw nice ones in Boston for $1.75, and had supposed that $1.50 to $2 was the outside price.

I believe there is money in the apple business. And I believe, as our speaker has stated, that better care and better treatment should be a point which we should consider, and what we must consider if we expect to succeed in the fruit-growing business in Massachusetts.

The CHAIR. Mr. Wood stated that his friend had so cultivated his orchard that he got a crop off every year, part on the even year and part on the odd year. Will he inform us what system of cultivation brought that about?

Mr. WOOD. He told me this was brought about by cultivating the land different years. One part of the orchard was cultivated one year, and the other portion the next year. He claimed he brought his crop in this way regularly. Some twenty-five years ago, — the even year is our apple year in New England, — down in Marshfield he saw on the odd year an orchard of 6 acres that was loaded with fruit, — borne down to the ground, — and in all other parts of the State we had few or none that year. His curiosity was excited, and he stopped over on the train and sought out the man who owned the orchard, and asked him how it was done. He said he bought the trees of a New England merchant, and when they first blossomed they blossomed on the even year. He had the blossoms all picked off, and the next year there were a few. When the second even year came, he had them picked off again; and when the

third year came round, he had them picked again; and from that time on he had his fruit crop on the odd year. I was interested in the experiment, and I had some scions from a tree that always bore fully on the even year and none on the odd year. In three or four years, when the first blossoms appeared, I had them picked off, and I had it followed for three years; and for twenty years I had no apples on those trees on even years, but did have a crop on the off years. About that time they began to come on the even year.

Professor WAUGH. I have seen this done, which I think is a still more feasible thing. Instead of having trees bear on the odd year, have them bear every year. I have seen this done on a large scale, in this way. Allow them to bear a moderate crop on the even year and a moderate crop on the odd year. I know that with some varieties this can be done; it cannot be done with all varieties, but with such varieties as Greenings it may be done very regularly.

Mr. A. M. LYMAN (of Montague). There is one fruit that has not been mentioned. Many of us are interested in the eating of it after it is prepared for the table. It does not grow on every farm in Massachusetts. There is a great fascination in growing that fruit. A gentleman here knows all about it, and I think we shall be glad to know about the cranberry crop.

Mr. JOHN BURSLEY (of West Barnstable). My friend Lyman has alluded to my knowing all about cranberries. I have been interested in them all my days, but I have got to that point when I feel that I know almost nothing about growing cranberries. There are one or two things which have occurred to me which will go towards strengthening the theories which Professor Waugh and Professor Sanborn have advanced. I have ever noticed that those men who practise the intensive culture with their cranberries, who are ever after the insects, fertilizing matter and weeds, succeed, when those who plant the cranberries and leave them to take care of themselves usually fail. We have those who are of a calibre that are able to practise extensive growing and intensive as well; those men are making a

marked success. They are growing and marketing the berries at $5 less per barrel than others, and are making a large percentage of profit. Their plantations are carefully attended to; the water is drawn off in the spring, and the weeds are taken care of; the insects are taken care of and destroyed either by flooding or spraying; the fruit is harvested and taken to the market in good condition, always of good quality, and it brings a good price. Those who do not make the culture of cranberries their sole industry are favored by marketing the fruit and selling it before it leaves the shipping points on the Cape at $1,500 and $1,600 per car. There is always some profit when they sell at these figures, and they are the men who are going to keep up our cranberry industry.

Mr. John G. Avery (of Spencer). In the town where I live and in the adjoining town there is considerable money invested in cranberry bogs. Those who are interested furnish men who do this work through the season. One man has returned, and he was telling me only a few days ago of the great success he had met with. I won't undertake to tell how many acres there are in that cranberry section.

Dr. J. B. Lindsey (of Amherst). There is one point I do not think has been dwelt upon quite enough, and that is, the importance of growing special apples here in western Massachusetts. We hear a great deal about the abandoned farms in this section, and it has always seemed to me there was a splendid opportunity for those who have enterprise and push to devote a considerable portion of this land to the growth of apples and peaches. I believe dairying, poultry culture and apple and peach growing could be made much more successful, if there was a little more interest; and it seems to me that Professor Waugh might drive home the nail by drawing attention to the advantage of growing apples and peaches on these farms in western Massachusetts.

Mr. H. A. Turner (of Norwell). Maine, New Hampshire and Vermont are said to be ahead of us in apple growing. In Plymouth County I hear there is a failure

in apple culture, and the reason is, because the farmers fail to pay the attention to the orchard that they do to the other crops. I believe they set out an orchard and for a few years attend to it and put a good deal of labor upon it, and then they go about their other farming, and leave the trees to take care of themselves. If they lose a few, they don't care. I don't believe they fertilize them. I believe orchards in many cases starve to death. They are neglected; they show signs of decay, and they saw off the decayed limbs; they trim them almost to death, but don't put on any fertilizer. Farmers our way don't think much of the apple crop, because for the last two years there have been heaps of apples lying on the ground. A man told me he had a lot of apples this year, and he told his son to sell them to the first man that came along. He sold them for 75 cents a barrel, but they were not such apples as you raise in this section of the State. There is too much indifference in Massachusetts in regard to the cultivation of apple trees.

Prof. F. S. COOLEY (of Amherst). This subject has been taking a wide range. There is a little section in the county of Franklin known as "apple valley," where the best Baldwins in Massachusetts and perhaps the best Baldwins in New England are raised. They grow so thick there on the trees that great records are made in picking them. There are two men who make particularly good records. Two years ago, when such a big crop was produced, they picked upwards of 50 barrels per day; this year one picked in one day 61 barrels; the day following, his brother in another orchard picked 64 barrels; and a little later, one picked 75 barrels in a day, for which he received $9.

Mr. JOSHUA CLARK (of Lowell). I don't know but this question is entirely off from the subject, but it is an important consideration. Speaking of extensive farming and intensive farming, the great trouble in our section is this, that when we go into extensive and intensive farming we cannot get help enough to gather the crops in. I have heard of quite a number who had apples this fall, and they

had to leave them on the trees. It is an actual fact. In the section of country where I live it is almost impossible to get good farm help.

Professor WAUGH. I don't know as I can tell you. One of the reasons why fruit can be grown profitably in Massachusetts is because it is easy ordinarily to get help. The best place to raise fruit is near large cities. One of the most important things is to be able to get women and children to pick. Around large cities it is always possible to get a good corps of pickers. It is almost impossible to raise fruit when you cannot get pickers. Here in western Massachusetts I am told it is almost impossible to get pickers.

Professor SANBORN. I have adopted this plan. I have put a little cottage on the farm, and put a man and his wife on it. Ordinarily, a man has no attachment for the farm. He works usually but for a few months. You place him in a cottage with his wife and children, and organize the farm so as to keep him busy the year round, and you will find the question is partly settled. The wife and children are able to help, also. But I believe the demand will furnish the supply after a while.

Secretary STOCKWELL. The Sutton Beauty I have a right to be proud of, because it originated in my native town, and because it is such an advance as an apple for the market. I am a believer in the Baldwin. It has been a wonderful apple for us, but we do not believe we have reached perfection in anything yet. We have a right to look forward to something better. I believe something better than the Baldwin has been found. The Sutton Beauty is taking its place.

EVENING SESSION.

The evening session was called to order by Vice-President Sessions, who said: "Mr. Forbush, the lecturer of the evening, is an ornithologist by profession, and has spent many and many a day in collecting specimens and in studying the habits of birds, and during the past months he has been spending his leisure time in that way. I have the pleasure of introducing to you Mr. Edward H. Forbush of Wareham, Mass.

TWO YEARS WITH THE BIRDS ON A FARM.

BY EDWARD HOWE FORBUSH, ORNITHOLOGIST TO THE BOARD.

Some investigations made, under the auspices of this Board, in the last years of the nineteenth century gave you abundant evidence of the usefulness of the smaller land birds in orchard and woodland; but no opportunity offered to study the influence exerted by birds on small fruit and vegetable growing until the year 1900.

This lecture is, mainly, the result of observations made by your ornithologist while at work on the land, and, much of the time, in his kitchen garden. The facts ascertained are such as any other observing farmer might gather, were he familiar with our common birds. The observations of which this lecture constitutes a partial record were begun in July, 1900, and have been continued up to a very recent date.

Since it is my intention to pursue these investigations further in the same field for the benefit of this Board, it will be well first briefly to describe the geographical position of the farm, climate, soil, flora and fauna. The place is situated in Wareham, Mass., on the north bank of the Agawam River, near its junction with the Wankinco. These two rivers, uniting here, form the Wareham River, a tidal stream. The salt water flows for some distance up each of these tributaries, and returning empties into Buzzard's Bay, three miles below.

The farm was selected as one lying directly in the track of both migrating land birds and water birds, and is well adapted to sustain a large and varied bird population. It lies near the head of Buzzard's Bay, in or near the line of flight of those migrating sea and shore birds which come up along the waters or shores of Long Island Sound in their

northward migrations, and, crossing the mouth of Narragansett Bay, pass up Buzzard's Bay or its west shore, crossing Wareham and Plymouth, and thus reaching the shores or waters of Cape Cod Bay, leaving Cape Cod out of their itinerary. The distance saved by such a course is from fifty to one hundred miles.

Observation shows that many birds take advantage of this saving of time and distance both in their northward and southward journeyings, though many more follow on around the devious shores of the Cape. Flights of land birds which have crossed the comparatively narrow channels of Narragansett Bay into Tiverton, Westport and Dartmouth are checked and turned northward by the broad expanse of Buzzard's Bay, most of them passing up its western shore, and, becoming somewhat massed here, spread out again over Wareham, Plymouth, Carver and Middleborough, on their way northward and eastward. The field of observation, therefore, is particularly favorable for the study of migrating birds.

The winters are comparatively mild, with rather more rain and less snow than falls in western Massachusetts. The thermometer usually remains well above zero, dropping to that point occasionally, but seldom remaining long below it. Snow does not usually lie at great depth, or long at a time.

We are somewhat protected from the east and north-east winds, which sweep the coast of Massachusetts Bay, by a tract of hilly and partially wooded country, sixteen miles wide, which lies between the head of Buzzard's Bay and the coast at Plymouth. Many birds, which forsake the colder and more snowy regions of the State in winter, remain along the shores of Buzzard's Bay all this inclement season. Jays, crows, flickers and cedar birds are commonly seen. Song sparrows, robins, shore larks, myrtle warblers and other land birds are more or less plentiful, in addition to the usual winter residents or migrants. Gulls and certain other sea birds winter here in some numbers. For the past two seasons a kingfisher has wintered along the river, and swamp sparrows and meadow larks are sometimes seen. It

will be seen, therefore, that even in winter the bird population is comparatively large.

The extreme heat of summer is tempered here by the south-west winds, which come laden, not with heat, as in many parts of the State, but with the cooling influences of the broad Atlantic and the salt flavor of the bay. The soil of the uplands is largely of a sandy or gravelly nature, with some clay deposits. Here and there rocks, left by the ancient continental glaciers, lie near the surface, either projecting above the ground or buried at moderate depths. As is the case with most soils of glacial origin, there is usually a greater variety in the character of the soils of limited areas (such as are contained in the ordinary farm) than in soils otherwise formed. One may readily pass at a single step from a dry and sandy soil to one very retentive of water, where he will sink into mud ankle deep. The soil being thus varied, the vegetation is, in consequence, quite diversified. We have not only the pitch pine, scrub oak, poverty grass and beach plums and bearberry of the stratified sands of Cape Cod, but also the birches, elms, oaks, maples, hornbeams, sassafras, white pine and cedars of a more fertile soil. These and other trees both of the coast region and the interior flourish here, with a profusion of berries of all native kinds, except perhaps the raspberry, high blackberry, barberry and wild strawberry, none of which are plentiful. There are very few nut and ash trees or white oak groves. There is a profusion of wild flowering plants, a great variety of shrubbery, and there are grasses which are not found in the interior.

A few birds which are common on the rocky hillsides of the western part of the State are not common in Wareham or its vicinity; but their absence is more than made up by the greater number of water, shore and marsh birds found here.

The tract of land which has been kept under observation consists of the farm, extending from the highway at the north to the water way — the river — at the south, together with the lands adjacent, and the waste lands in which the river rises and out of which it flows. From the shore

of the river at the southern boundary of the farm we may look across a fine sheet of water, where the three rivers join, to the village at Wareham station. Beneath these waters, oysters, clams and quahaugs grow naturally. The river at times swarms with edible migratory fish. Shrimp, crabs and other aquatic and marine forms of life abound.

Such a variety of food animals is sure to attract water birds. Down the river, toward the bay, gulls or terns, or both together, may be found according to the season. Sea ducks are not wanting. Loons and grebes come and go. The upper river, flowing through salt marshes backed by pine woods, offers secluded retreats for eagles, fish hawks, herons, bitterns and various water fowl and shore birds. One large, solitary pine tree standing on our shore has been used for at least two years, in the fishing season, by an immense bald eagle as a perch, from which he watches the evolutions of the fish hawks.

If we follow the river above the head of tide water toward the Plymouth woods, we shall see another feature of this region which renders it attractive to birds. Here lies an uninhabited country. There are no dwellings and no fences. The only buildings to be seen are the "bog houses," where cranberries are housed, screened and packed for shipment each fall. The land is undulating, consisting of a series of low hills, with occasionally a well-watered valley. Many of these valleys have been made into cranberry bogs. There are many natural ponds lying in sheltered basins, and other artificial ponds which are used for flowing the bogs.

This country no doubt was once well wooded. Then the white pine woods extended well down on the Cape, and oak timber grew there; but for years past parts of this region have been visited by forest fires, until much of the wild land down through Sandwich, Barnstable and Falmouth has been burned over. Large tracts are now denuded of trees. On these tracts scrub oaks, pitch pines and berry bushes spring up. When these are burned, the ashes from the fire supplies the earth with sufficient potash to produce a great crop of berries about the second season following.

Large tracts of this burned land are covered mainly with berry bushes; hence the saying that "the Cape is one great berry pasture." The low or dwarf species clothe the hills, while in the lower valleys and swamps the higher berries grow to perfection. Here birds find an abundance of fruit during the summer and early fall months. The swamps furnish them sheltered roosting places. The ponds and bogs furnish food and resting places for wild fowl and marsh birds. The dead wood is an attraction for woodpeckers, and the wood birds find a congenial habitat in those portions of the standing timber still spared by the flames. Most of the country for miles to the north is of this character. To the west toward Rochester the land is divided into farms, consisting of cultivated land, grass land and woodland, such as may be seen generally throughout eastern Massachusetts.

Now, let us look at the condition of the farm itself, when acquired, that we may consider its unaided capacity for attracting and sustaining a variety of bird life. The owner having left the place, it had been occupied for some years by tenants. This occupation had not conduced to its improvement, inasmuch as some land that might have been tilled had been left to the processes of nature, and had grown weeds, shrubbery and young trees. Such tangles, however much they may interfere with good farming, seldom fail to hold out some attraction to birds, and for this reason they may be allowed to remain wherever it can be done consistently with the purpose of the utilitarian.

As there were less than nine acres of land cleared, it was in the owner's power largely and immediately to control the conditions necessary to accommodate a change or increase of bird life, for trees can be cut much quicker than they can be grown. One cannot expect to have many species of useful birds about his farmstead, unless he has, or can provide, in addition to his open or cultivated fields, a variety of trees and shrubbery. These will furnish birds food and shelter, roosting and nesting places, and retreats to which they may fly when pursued by their enemies of the air. Most land birds prefer the neighborhood of trees, and many

species will not inhabit a treeless locality, for some nest almost altogether in the woods. Most birds prefer a well-watered locality. Water is furnished to the farm and adjacent land by several springs and small streams flowing to the river.

The kitchen garden, where most of the observations hereinafter recorded were made, is situated in the rear of the farmhouse, and is devoted to the cultivation of vegetables and small fruits. The soil, vegetation and management of the land immediately about it vary greatly. To the west are, first, a few orchard trees; next, a line of evergreens for a wind-break; and beyond these about one hundred acres of open fields and meadows, where meadow larks and other native ground-breeding birds resort. The lower portions of the meadows nearest the river are frequented by blackbirds. Along the bushy borders of the higher fields birds of both upland and lowland mingle. Here the quails and pheasants lead their tender broods, always alert to guard them from the low-flying marsh hawk or the sneaking fox.

North of the garden the lowland is grown up, mainly, with birch and maple, hedged about with a thicket of shrubbery in which are mingled alders, berry bushes and fruiting vines. This tract is largely covered with thick undergrowth, where the trees are scattering. It is backed to the east by a few tall, lone pines, beyond which lies a high, sandy, open field, and then a small orchard. To the north it is bounded by a small cranberry bog, and beyond this a sandy knoll rises to the road. This low-lying open woodland, with its rich soil, dense undergrowth and tangle of vines, furnishes a good wind-break for the garden, shutting off the cold, north-west winds. It also provides a sheltered, sunny retreat for birds in the piercing cold, but usually pleasant, winter weather when these winds are very searching on the open fields. Such a retreat is equally grateful to birds on cold days in spring and fall: and it forms an admirable breeding place for thrushes, robins, vireos, towhees, song sparrows, ground and bush nesting warblers.

East of the garden the ground rises gradually, the soil changing from a bluish-black to a dark brown, then from

brown to yellow, until, as we reach the hilltop, we find what was undoubtedly once a sand dune, like those of Cape Cod or Cape Ann. Here the only soil is almost a pure sand, and little will grow but poverty grass and other primitive plants. Most of this rise is covered with a rather thin growth of pitch pines and white pines, but a thick belt of trees on the north gives additional protection to the garden and the poultry houses. Fowls do well here, for the exposure is sunny and the soil sandy. In the scrub oaks along the hill-side, towhees, brown thrashers and cuckoos thrive. Here the notes of the pine warbler, wood pewee and field sparrow are heard in spring. East of this wood an open field with scattering trees leads to a neighbor's house on the hilltop. South of garden, house and barn lies the "robin roost," a grove of white pines, about forty-five years old and some six acres in extent. Here the robins roost in numbers in early spring, late summer and early fall, when they come in at dusk by hundreds.

This is a breeding ground for jays, robins and squirrels. Green herons often roost here. Warblers, kinglets, titmice or creepers may be found in this grove almost any day during the entire year. For most of the season the grove is left to the birds, except for a part of each summer, when two summer cottages within its confines are occupied. There is a spring-fed pool in this grove, where pond lilies, fish, frogs and turtles form a combination which seems to attract both feathered and unfeathered bipeds. This pool provides a bathing and drinking place for the birds of the grove. Here herons and kingfishers stop to fish. Here hawks stoop and wild fowl occasionally rest. South of the grove is a field of three acres, devoted now to the cultivation of sweet corn, roots and other vegetables. This field is also surrounded by woods on three sides, with a belt of trees and shrubbery for a wind-break on the fourth or west side. This wind-break separates the field from a tract of lowland of some fifteen or twenty acres, once mainly salt marsh, but now, diked off and reclaimed from the river, it forms a cranberry bog. A pool of an acre or more lies in the centre of the bog. This was formerly an arm of the

river called the "toad hole," and often swarming with fish. It is still a breeding place for toads, and also a resort for herons, bitterns or shore birds in their seasons. Swamp sparrows, sharp-tailed finches and rails frequent its marshy borders.

I have been thus particular in describing the surroundings of the farm, because its fitness for attracting a variety of birds seems to be almost ideal.

In studying orchard birds, we learned that orchards surrounded in part by woods and in part by open fields were more frequented by birds, and therefore better protected against injurious insects, than were those surrounded by fields alone. The assumption that a garden similarly situated would also receive a like measure of protection was perhaps warranted. On such an assumption the selection of the location for a garden was partially based. Our first task was to attract as many birds as possible to the garden. No attempt will be made now to give a list of the different species of birds found in the locality. Were such a list given from the experience of only two years, it would be merely provisional. Most of the birds common to the farms of Massachusetts are found here: a few exceptions will be noted later.

As the place was not acquired until July, 1900, all that could be done that season was to attract the fall and winter birds to the farm yard and garden. When the frosts came, suitable food materials, attached to the trees and scattered upon the ground or snow, caused a gathering of the birds from far and near.

The larger part of the birds remaining with us during the winter belong to the sparrow family, and are all seed eaters. Most of them feed their young largely upon insects, but breed far to the north, mainly beyond the limits of agricultural regions, so that during the breeding season their value to man as insect eaters is not great. As fall approaches, and frosts drive to their winter hiding places the insects on which these birds feed in spring or summer, the sparrows begin to feed on the now ripened seeds of wild grasses and other plants which sparrows are especially fitted by nature

to destroy. At this time our native sparrows, the song sparrow, chipping sparrow, field sparrow and others, which have been feeding largely for some time on the seeds of weeds and grasses, begin their southward migration, and the northern sparrows come in to take their place. The white-throated sparrow is among the first to appear, followed closely by the fox sparrow, the junco (or black snow bird), and last of all the tree sparrow. Still later, when heavy snows fall, one may see the snowflake, also called the snow bunting or white snow bird to distinguish it from the black snow bird or junco. The fox sparrow lingers awhile, and follows the whitethroat south; but the junco and the tree sparrow remain all winter, or so long as they can find food. A few song sparrows also linger through the winter, while now and then a swamp sparrow is seen. Now, if you watch these birds during the fall and winter months, you will find them feeding almost constantly on the seeds of weeds and wild grasses. They visit neglected corn fields and potato fields, roadsides, gardens and old fields grown up to weeds, where they literally cram themselves with the seeds, and put on fat rapidly. These birds are so full of seeds in the fall or winter that often if one is shot, held up by the feet and shaken, the seeds will flow from its mouth. These seeds are seldom passed whole through the alimentary canal of the bird and left to germinate when dropped in the excreta, as is the case with some of the seeds swallowed, for instance, by the crow; but they are ground up by the tough, gizzard-like stomach of the sparrows, and their nutritious parts are thoroughly digested.

The goldfinch, which remains with us throughout the winter, is often seen clinging to the tops of the weeds, taking the seeds directly from the plant. More or less of this kind of work is done also by redpolls, siskins and crossbills. The tree sparrows also feed largely by alighting on the plants and pecking off the seeds. The juncos and song sparrows take more of the seeds from the ground after they have fallen. These birds and the fox sparrows also scratch away the fallen leaves or grasses to get at seeds buried beneath them.

Where these birds are numerous in the fall, winter and early spring, they destroy nearly all the weed seeds to be found. This is well shown by Dr. Judd, in his admirable report on the relation of sparrows to agriculture. On a Maryland farm in 1896 he found sparrows swarming during the month of December. In a tangle of smartweed the ground was literally black with seeds which had been cracked open by the birds and the meat removed. In a rectangular space eighteen inches square were found 1,130 such remains of seeds and only 2 whole seeds. The birds fed in the locality well into May, and *no smartweed grew the ensuing year where the birds had caused this extensive destruction.**

Prof. F. E. L. Beal, who has perhaps made as extensive studies of the food of birds as any one now living, estimates that the tree sparrows in the State of Iowa eat 875 tons of weed seed each winter, and he allows only 10 birds to the square mile.†

Good farmers are supposed to grow no weeds; but any one travelling through Massachusetts in August or September may be surprised, perhaps, to see that most farmers grow them abundantly. Most of the fields where corn, potatoes and other crops have been grown are so covered with weeds at that season that in many places it is difficult to see the crop from a distance. No doubt these rank growths are a compliment to the soil, but they are no compliment to the cultivation. The fields of Massachusetts are not alone in this condition. In truth, there are more weed seeds for the birds than birds to take care of them. Where the hay fields and meadows are closely and often cropped, fewer weeds have a chance to mature their seed; but even there some low-growing plants are left, which survive the cutting, and weeds come in. Where weeds are allowed to grow all through the fall months, birds cannot be expected to destroy them all.

In our garden we have attempted to keep the weeds in subjection. This in 1900 was almost an impossibility. In

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* Bulletin No. 15, Division Biological Survey, United States Department of Agriculture, p. 28.

† Farmers' Bulletin No. 54, United States Department of Agriculture, p. 28 (1897).

1901 it was a serious task, and necessitated frequent weeding or hoeing all summer and into the fall. In 1902 the labor was much lightened, and this was in part due to the birds. All farmers know that, while hoed crops in the main may be kept nearly free from weeds, it is impossible to weed a squash or melon patch without injuring the plants. Such crops invariably foul the land. It is also very difficult to keep all fences and borders of fields clear of weeds. We depended mainly on the birds to take care of such weed seeds as were left in the squash or melon patch or along the borders, and they did their work well.

The first year, birds were not numerous enough to destroy all the weed seed; the second year, there was hardly enough seed to gather an increased number of birds. A small patch of Japanese barnyard grass (*Panicum crus-galli*) was planted north of the garden. The seed of this millet proved very attractive to birds, but it was not molested except by goldfinches and an occasional English sparrow until the seed began to fall. The millet was then reaped and the seed saved, but not until a great quantity of it had fallen to the ground.

All the fall and winter this seed proved a great attraction to the birds. Sparrows were almost constantly feeding in the vicinity, and the seed seemed to be relished by all of them. There were probably some bushels of this seed on the ground in the fall, but by spring hardly one could be found, and only a very few scattering plants grew there the following spring. This plant is merely a cultivated variety of a common wild grass or weed, hence its attractiveness to birds.

Juncos and tree sparrows came in greatest numbers. They not only destroyed the millet seed, but they also found and ate practically all of the weed seeds remaining. The sparrows eat usually with avidity the seed of many of the worst weeds known. Dr. Judd mentions the following weeds which are troublesome in fields and hoed crops, and which are eaten by some twenty species of sparrows: ragweed (*Ambrosia artemisiæfolia*); several species of the genus Polygonum, including bindweed (*P. convolvulus*),

smartweed (*P. lapathifolium*) and knotweed (*P. aviculare*); pigweed (*Amarantus retroflexus* and other species); nutgrass and other sedges (*Cyperaceæ*); crab-grass (*Panicum sanguinale*); pigeon-grass (*Chætocloa viridis* and *C. glauca*); lamb's-quarters (*Chenopodium album*); and chickweed (*Alsine media*).

Chickweed, ragweed, smartweed and purslane are among the weeds whose seeds have been freely eaten by sparrows in our garden. Purslane is so tenacious of life that branches cut off by the hoe and thrown on the soil will at times take root and grow lustily. Chickweed is particularly prolific, because of its deceptive habit of blossoming and developing seed at the same time. In all these weeds the farmer will recognize foes worthy of his steel. Some of the sparrows are also particularly useful as insect destroyers, as we shall see later.

While speaking of sparrows, lest error be promulgated, it should be definitely stated that the English sparrow (*Passer domesticus*) cannot be included in the list of birds beneficial to the garden. This bird feeds on grain to the amount of more than two-thirds of all its food; is destructive to peas and other garden vegetables, as well as fruit; and destroys comparatively few insects. It eats perhaps less than half as many weed seeds as any of our common native sparrows, and makes itself generally so disagreeable as to prevent many other birds from breeding in the neighborhood it inhabits.

Our work, in conjunction with that of the birds, had been so efficient in exterminating the weeds that during the winter of 1901–1902 it frequently was necessary to scatter chaff and hayseed from the barn floor around the dooryard, to provide sufficient food for the birds. In severe winter weather the scratching sheds connected with the poultry houses always furnished them a place of refuge. These sheds open toward the south (which side is covered with poultry netting), but are closed on all other sides. The ground in these sheds is somewhat deeply covered with litter, in which wheat screenings and small grain are scattered, to give the hens exercise in scratching it out during

the day. The fowls are not admitted to these sheds very early on cold or stormy mornings. Two sheds having no curtains, the sparrows invariably occupy them at such times, even if they do not remain through the night. They are protected from hawks and cats by the netting, and they busy themselves in searching and scratching among the litter for weed seeds and the small particles of grain overlooked by the fowls.

Here and in two open sheds at the barn the winter sparrows can always find food and shelter. The woods and shrubbery around the garden offer the sparrows a refuge to which they can retreat at the least sign of danger. This is an advantage which not all gardens possess. The song sparrow and the junco do not like to go far afield if they can secure food, as in this case, near cover. The snowflake, on the contrary, seems to prefer open fields and pastures, trusting perhaps to its protective coloring or to its skill in flight, for it rarely stops in the vicinity of the garden.

During the first winter some little attention had been paid to methods for attracting the insect-feeding winter birds. Animal food, such as bones, suet and dried meat, was hung upon the fruit trees, and attracted some attention from chickadees, jays, nuthatches and woodpeckers. These and the sparrows formed a merry company, which served to attract other birds, so that before the end of the winter most of the commoner land birds found at that season frequented the place. The effects of their presence was noticeable in the scarcity of injurious insects in the spring. The next problem in the sequence of the seasons was to induce members of the spring flight of birds to remain with us to breed. To this end it became necessary to increase the inducements to nest building, and offer material for bird homes.

As spring opened, the place was looked over to see what nesting sites were available to those birds that prefer to breed in hollow trees. There were practically none. The recent tenant on the place had been allowed to use for fuel such dead wood as he could find. He had availed himself of his opportunities, until hardly a dead tree remained.

Having continued this practice for the past two years, I am led to believe that usually it is bad policy. It has resulted in a scarcity of the smaller woodpeckers, which ordinarily hold destructive bark beetles and other wood-boring insects in check. As a probable effect of this scarcity of these useful birds, the *Scolytidæ* and some of the larger borers are now beginning to injure the living trees. The practice of cutting out dead timber also removes the breeding places for wrens, swallows, bluebirds, screech owls, chickadees and other useful birds. No bluebirds, swallows or wrens were found breeding on the place. The screech owls and flickers were driven to take refuge in the summer cottages. It was evident that an attempt should be made to bring back such birds as would accept artificial substitutes for their natural breeding places in trees.

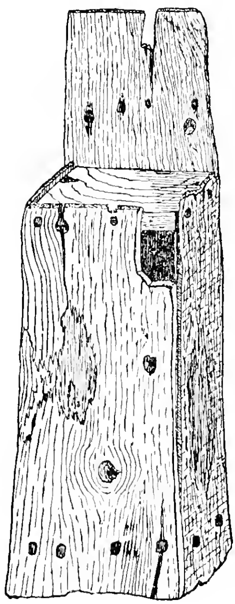

FIG. 1.—Shingle Box.

Early in March, 1901, a number of bird boxes were put up on the trees about the borders of the woods. These were purposely made of old, weather-beaten lumber, and were inexpensive, four of the shingles removed when shingling the barn and a bottom and top piece of boards completing each box, as shown in Fig. 1. Bird boxes put up in this locality should face to the south or west. If placed thus and on the south or west side of a building or tree trunk, they are not so much exposed to the cold storms which so often occur in early spring; but they should be put in cool and shady situations, if intended for wrens. The hole should be placed near the top, and should not be over seven-eighths of an inch in diameter (Fig. 2). A seven-eighths-inch hole is large enough for wrens or swallows, and the one-inch size will do for the bluebirds. The seven-eighths-inch hole will certainly exclude English sparrows, and, if there is no perch connected with the box, they

will not be likely to trouble bluebirds. The hole always should be small enough to keep out blue jays, gray squirrels and owls. The openings to the boxes put up in 1901 were too large, and, although many birds came to them, they were so annoyed by their many enemies that only one pair of bluebirds succeeded in raising a brood, no other birds occupying the boxes. Two pairs of English sparrows began operations, but were not allowed to proceed.

Nesting materials were scattered about and hung from the branches of the trees, so that bluebirds, wrens and swallows might have unlimited material at hand. This was continued in the spring of 1902, but only three broods of bluebirds, two of which were raised, were hatched in these boxes. No swallows, martins or wrens succeeded in occupying any of the boxes. The experiments in this direction have resulted in a partial failure, mainly through the abundance of the birds' enemies. In respect to the chickadee, however, this experiment has given results which will compensate in a large measure for its failure in other directions. Studies of the food of the chickadee have convinced me that it is perhaps the most useful of all birds in the orchard, and as valuable as any in the forest or woodland. This bird destroys vast numbers of such orchard pests as the canker worms and other soft caterpillars, taking also the hibernating forms of these insects, whether eggs, larvæ or pupæ, in great quantity. It also destroys the eggs of the forest caterpillar moth (*Clisiocampa disstria*) and those of the common tent caterpillar (*C. Americana*) to some extent, killing large numbers of the caterpillars of both these insects, as well as those of the gypsy moth (*Porthetria dispar*), the brown-tail moth (*Euproctis chrysorrhœa*) and

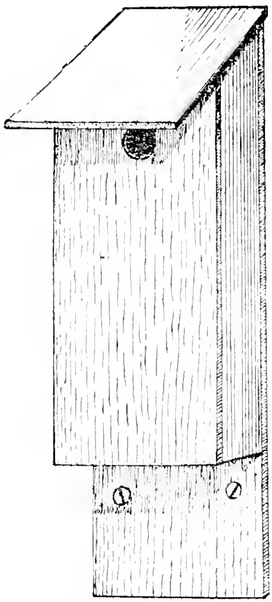

FIG. 2.—Sparrow-proof Box.

other hairy caterpillars. It is a great feeder on the plant lice (*Aphidæ*), and the bark beetles (*Scolytidæ*) are also eaten by it. These insect families comprise some of our worst tree pests. These birds are continually searching over the bark of the trunks, limbs and twigs of trees. In this occupation they find and destroy the eggs of moths and plant lice, the cocoons of the codling moths (*Carpocapsa pomonella*), case bearers (*Microlepidoptera*), leaf miners and many injurious minute insects. They also open twigs infested by borers, removing them with certainty, though with less skill than the woodpeckers exhibit. Nor is their work confined wholly to the trees and shrubbery, for in the early spring, when the snow has gone and the warm sun begins to cause the first stir of life among hibernating insects hidden in the forest floor, the chickadees descend to the ground, where they search among the leaves, extracting worms from decaying chestnuts or acorns which have been overlooked by jays and squirrels, or digging out pupæ which have either hibernated among the leaves on the ground or fallen with them from the trees. Such insect food as given above forms the main part of this bird's sustenance, nor has it any bad habits, so far as known. When driven by extremity, it may eat a few bits from worthless apples frozen upon the trees, or pick up a few fragments of corn or oats by the roadside or in barnyard or poultry yard; but apparently it prefers, in such cases, the berries of the sumach, and never injures cultivated fruit or grain of any value. It has none of the bad habits of some of its European relatives. Its nesting habits and its confiding nature led to the belief that it might be so domesticated as to become as attached to our homes, in time, as the English sparrow is to-day. What a benefit might have been conferred on our city parks, had we induced these birds to breed there, instead of importing the redoubtable sparrow!

European titmice breed quite freely in boxes put up for them, and their numbers can be increased readily under man's protection. The American crested titmouse is said to breed occasionally about human habitations; but the chick-

adee, our most common titmouse, has mainly held aloof from human dwellings during the breeding season.

Thirty years ago, before the English sparrows became plentiful, this bird bred in the hollow trunks of old apple trees in orchards or dooryards, and does so to-day where the sparrows have not obtained a foothold: but it has been driven from such localities by the sparrow, returning to its old haunts mainly in the winter, when sparrows resort much to the city or village streets. Chickadees may be induced at times to build in partially decayed birch stumps by simply boring a seven-eighths-inch auger hole into the side of the stump, at a point three or four feet from the ground. The birds, finding a hole already begun, will finish it and build a nest there, as they do sometimes in the excavations made by woodpeckers. Believing that these birds might take advantage of a nesting box if it were provided for them, we first cut away all the dead stumps within a radius of about two hundred yards of the house and garden. Then food was put out in the winter on branches fastened to the house. A small pine tree was placed near the kitchen window and another at the dining room window, and these were hung with bits of dried meat, bone and suet. The chickadees

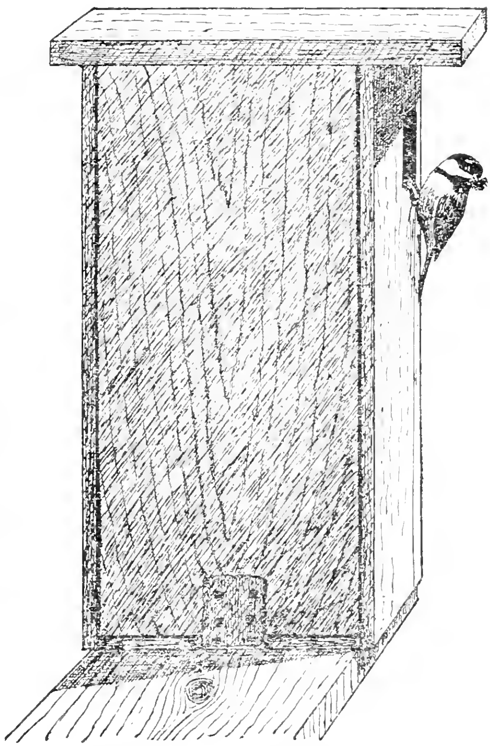

FIG. 3. — Observation Box closed.

and other birds soon found them, and came to them regularly day after day and hour after hour, continuing their Christmas festivities all winter and well into the early spring. A single bird box was then put up at a window in a loft over the woodshed. This was made after a pattern I began using thirty years ago, and may be called an observation box (Fig. 3). As shown in Fig. 4, it is provided with a door, which consists of a hinged side facing the window, and which can be opened at will by the observer. A pane of glass is also inserted in this side, so that, when the door is opened, the eggs or nestlings are protected by the thick glass from dangers without. Such a box must be so placed that the sun cannot shine into it, as this might endanger the lives of the young birds. By this time the English sparrows had all been shot or driven away from the premises, the mice and squirrels had been ejected from the bird boxes, and the chickadees began to manifest some curiosity as to the purpose of these curious habitations. As spring approached, a chickadee was seen now and then to enter one of the boxes. The one over the woodshed was inspected frequently, and it is believed that toward spring one or more of the birds passed the night in its shelter.

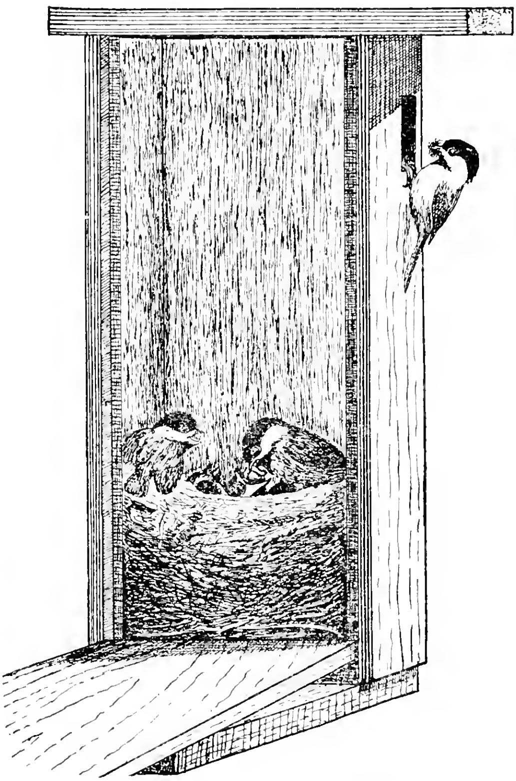

FIG. 4.— Observation Box open.

When spring opened and most of our little friends retired to the woods, one pair remained behind and made their home in the observation box. Another pair set up housekeeping in a birch stump not far away in the edge of the pine grove. The pair in the box, having abundant nesting material at hand, soon began building. Here was an excellent opportunity for watching the construction of the nest, but the box was not opened or disturbed, for fear that the birds might forsake it.

All in the house were enjoined to keep away from the box until the birds were seen carrying food to the nest. The box was then opened, and seven young birds were found. From this time on the feeding and growth of the young birds were observed through the glass. Mr. C. A. Reed, the editor of "American Ornithology," became interested in this young family; and on June 10, having been notified that the birds were ready to leave the nest, he came with his camera to photograph them. The old birds had now become so accustomed to our presence that they would come and feed the young while people were at the open window within a foot or two of the box. When sitting at the window, one could see plainly the insects held in the beaks of the old birds. Large insects were brought singly, smaller ones in bunches or masses, — one almost might say in mouthfuls.

The old bird gathered ants, plant lice, spiders, etc., in its bill until that was well filled, when it flew quickly to the box, fed the young, cleaned the nest, and, taking the excrement in its bill, flew away for more food. Sometimes the most greedy youngster got the whole mouthful, at other times the food was divided among the young. The following notes, taken at the nest while the camera was in position, June 10, will show how little the birds were disturbed by our presence, and how often they came with food that forenoon. The box was opened and the camera set up at 9.50 o'clock. At 9.52, the female chickadee came with a large, dark caterpillar. At 9.54, the male bird came with a light, geometrid caterpillar. At 9.57½, the male bird brought two caterpillars. At 9.57½, the female brought

one large, green caterpillar. At 10.02, the male brought a pupa about like the codling moth. At 10.07, the male brought a grasshopper with legs trimmed off.

While the male was there the female came also with a bunch of spiders' eggs, and, following the male, fed immediately. We then removed the glass, and, reaching out, pushed down the side of the nest so that an attempt could be made to photograph the young, which were sunk down in the nest quite out of sight from the camera. At this the young made a noise which sounded much like the loud hissing of a snake, but proved to be an attempt of all seven at once to scold in chickadee language.

This disturbed the old birds, who showed some anxiety, and did not feed again until, at 10.14, the female brought a green caterpillar; at 10.17 a heavy team went by, but the male came again, at 10.19, with a large caterpillar, and again at 10.22 with smaller caterpillars. At this time the largest and most active young bird, which had been quite restless and had several times attempted to reach the entrance hole, made a dash, and flew, at the first attempt, to a maple tree near by; but failing to alight there, it fluttered on to a stone heap at the foot of a pine tree some four rods away. In this remarkable feat it no doubt was aided by the strong breeze then blowing. This bird was later captured and returned to the box, but refused to remain, and the second time flew to a pine tree several rods farther off, reaching it in two flights. This diversion somewhat interrupted the regularity of the feeding, as the old birds devoted most of their attention to the young truant. The female came to the nest once at 10.23 with ants, plant lice and a spider, and the male came directly afterward with similar food. At 10.24 the female came again, and at 10.24½ the male came; at 10.28¼, the female; at 10.34, the male. At this time the food, which came in large mouthfuls, consisted mainly of ants and plant lice. At 10.36, as I leaned from the window to put in the glass, the mother bird came with her beak full of insect food and alighted at the entrance hole. At this time one hand held the glass, while the other rested on the box. The bird

clung to the side of the box, regarding me at first with some suspicion, but soon went in and fed the young a large, green caterpillar which she had brought. While I kept this position both birds came again, the female going in at once and feeding the young as before; but the male alighted on top of the box, scanning my face with his bright dark eyes for some time before he would trust himself to enter. The young were evidently fully fledged and ready to fly. Two of them had already flown and had been returned to the box. The old birds stopped feeding them and began to call. They were answered by the young. At this moment the old birds flew, one to the box and the other to the edge of the roof overhead, while the young all sprang out in quick succession, all but two of them alighting on my arms, head or shoulders, much to the delight of the children, who were watching from below. The old birds came to me and piloted the young to the branches of a pear tree near by. This happy family remained about the vicinity for some time, and probably still forms a part of one of the flocks of chickadees now in the neighborhood.

This account is given with all its details to show how readily the chickadee will accept our hospitality, and how valuable an acquisition it would be to the birds which nest about the farm buildings, and with the hope that others may be led to experiment with it in the same way. This family of chickadees and a family of bluebirds, that was raised in a box on the apple tree near by, kept the fruit and shade trees near the house quite free from injurious insects. A nest of the tent caterpillar which appeared on the apple tree where the bluebirds built their nest was rifled of its contents. Two young apple trees that swarmed with plant lice were almost entirely cleared, and suffered no injury; while two on the hill beyond the garden, where the chickadees did not go, suffered much from these pests, and finally died. With eleven hungry nestlings to be fed, the few canker worms hatched from the eggs overlooked by the birds were soon disposed of.

Now, let us return to the garden. The care of a garden seldom fails to banish sleep in the morning. The least

sound is sufficient to arouse you. At a light, intermittent pattering sound on the roof you are awake at once. It is only a gray squirrel running over the roof. As you rise to prepare for the duties of the day, it is hardly light enough clearly to distinguish objects in the grove. From the wooded brookside the sweet and solemn tones of the wood thrush float tremulously to your ear. Now a robin sings boldly from the top of a tall tree, where he can see the promise of day in the east; another takes up the refrain, and by the time you have reached the garden the full bird chorus pours forth from the surrounding woods. Mingled with the refrain you hear the distant trill of the chipping sparrow rising and falling like the breath of a sleeper in the fields. The oven bird awakens the echoes of the woods with a *staccato* note. The light, cool breath of the morning fans your cheek as it comes up from dewy meadows laden with the fragrance of lilies and azaleas. The eastern sky is rosy with the dawn, and as you gaze upon the beauteous scene dark shadows fade and fly. Aurora climbs the glowing firmament and morning walks abroad upon the fields. With a heart filled with thankfulness you slowly sink on bended knee and *go to killing squash bugs*, — otherwise, you would get few squashes. Much as the farmer may admire the beautiful in nature, he cannot spend the early morning hours in idle contemplation.

As you look abroad over the garden, you see robins hopping here and there, searching for earth worms, cut worms and grubs. Early in the season robins find many earth worms, but later, as the soil loses much of its moisture, these worms cannot be found so readily, as they descend to greater depths, and the robin must depend largely on insect food for its own subsistence and nourishment for its brood. Owing to the abundance of the robin in our neighborhood, it easily led all other birds as a destroyer of garden pests. It is one of the few birds that habitually seek their food on the ground in the garden early and late when the cut worms are abroad. The abundance of robins in the vicinity may be accounted for in part by their fondness for their roost in the pine grove. In 1901

Fig. 5.—The Robin on her Nest. (Copyright by C. A. Reed.)

there were more than thirty robins' nests in trees in the woods or fields near the house. There were three in a large pine in front of the house, and three more over the door of a summer cottage near by. Although most of the eggs or young in the nests were destroyed by the various enemies of birds, there were usually from three to six young robins about the garden most of the summer, and in May, June and July there were many adult birds. No sooner would any one go into the garden with plow, harrow, cultivator, hoe, fork or spade, to stir the earth for any purpose, than the robins would follow, picking up grubs, wire worms, earth worms, cut worms and ground beetles. There were few insects they would not eat. They soon became so tame that they would approach within a few feet of the worker, and if grubs or worms were tossed to them they would come and pick them up from the ground.

The white grubs, as most of you know, are the larvæ of May beetles (*Lachnosterna*) of different species, and destroy the roots of growing plants. They are serious pests in grass land or among hoed crops. Where numerous they will soon ruin a strawberry bed or a grass field, and because of their habits of burrowing in the ground they are hard to control. The wire worms, which are the larvæ of snapping beetles (*Elaterids*), also live under ground, and destroy the roots of plants, in some cases burrowing into the stems. They are destructive to turnips and other root crops, as well as to cabbage, celery and many vegetables, and must greatly reduce the productiveness of grass lands.

The cut worms are larvæ of *Noctuid* moths, and probably do as much injury both annually and periodically as any other pest we have. They not only eat the foliage of many plants, but they cut off the stems of young vegetables close to the ground, destroying the crop. As they feed mainly at night and hide under ground or under some shelter during the day, they are seldom noticed until the damage is done. Ground beetles (*Carabidæ*) are usually classed as useful insects; but, as many of the species feed quite largely on vegetable matter, their usefulness no doubt depends to some extent on their being kept within proper

bounds. Several genera have been known, where numerous, to destroy grass, weeds, grain or fruit. Some of them, notably of the genus *Harpalus*, are becoming widely known as destroyers of the fruit of the strawberry. Members of this genus were found eating the seeds of the Japanese barnyard millet along the borders of the garden. The robin constitutes a natural check on the increase of these creatures, which, if held in their place, are no doubt beneficial, but, if allowed to become too numerous to subsist on their natural food supply, will destroy cultivated crops.

The skunk has the reputation of being the most efficient enemy of the white grub; but here, where both skunks and robins were searching for food, the robin's work was the most effective. The onion and carrot beds were regular breeding grounds of these grubs. The hand cultivator was run frequently between the rows, and robins ran after it. In fact, the robins cultivated those rows more assiduously than did the cultivator. They picked up the insects that were turned up by the cultivator, they dug conical holes around the plants, almost always unearthing a grub at the bottom of each hole. This work they persistently followed up, day after day and week after week. So persistent were they that very few of the roots were found injured at harvest time by either grubs or wire worms. Probably some credit for this result must be given to the moles, that occasionally burrowed beneath the plants along whole rows, and undoubtedly secured some of these grubs which the robins failed to reach. Throughout the season the robins were watched as they fed their young, and it was seen that they habitually fed grubs, cut worms and many of the most injurious caterpillars. The larvæ of large insects seemed rather to be preferred, and the robins, when going to the nest, often took several insects at each trip.

One day while spading a small plot in the garden I watched a robin that came to feed. She came and picked up a large white grub that had been turned up by the spade, laid it out upon the unspaded ground, dug out another, laid it beside the first, and after hopping some distance secured still another large one, which she took to the

spot where the first two still lay. After several ineffectual efforts, she succeeded in getting a firm hold on all three, when she flew at once to her nest near by, fed them to her young and came back for more. The whole proceeding did not occupy five minutes. These grubs were dug out by the robins wherever they could be found. They took them from compost heaps, from beneath the mulch about the fruit trees, and seemed to know, as if by instinct, just where to find them. It should not be inferred, however, that they found these grubs by instinct. Their skill in finding them was acquired, and no doubt was entirely a matter of early education, except in so far as their keen faculties of observation were transmitted to them by their parents. The young robins, when they first left the nest, were nearly helpless so far as finding food was concerned, and it was some weeks before they had learned to find grubs with certainty. At first they were fed almost entirely by the parents; later, they learned to pick up objects from the ground and to pursue crawling insects; but they did not acquire, during their first summer, the skill evinced by their parents in digging out grubs. An adult bird, when once it began to dig, seldom missed the worm or grub. The young birds frequently failed to secure their prey, and were fed more or less by the old birds for some weeks after leaving the nest.

The first season (1901) we set out a few rows of strawberry plants of different varieties, to determine which were best suited to the soil. It is perhaps needless to add that the robins got nearly all of the fruit. This created, as it usually does, a rather unreasonable prejudice against the birds. In this the whole family shared; but, had the robins been killed then, there is little doubt that our strawberry beds would have been ruined in 1902. A close watch was kept on the robins in the strawberry bed in 1901, and they were seen to devour, on the average, five insects to each strawberry. These insects were nearly all such as were injurious to strawberry plants, and were taken either from the plants they were feeding on or from the ground beneath. When in 1902 the number of strawberry rows was much increased, the injury done by robins to the fruit was pro-

portionately very small; and a new bed, planted on the ground originally swarming with white grubs, did very well. The robins had so nearly exterminated the grubs that but few plants have been lost.

The robins occasionally took a raspberry or currant. They also took insects from the currant bushes (presumably currant worms). Their heaviest toll of fruit was taken from the cherry trees. In some localities their attacks on the cherries have been prevented by growing the Russian mulberry, — a fruit they often prefer to the cherry; but this is not always a certain remedy, and it is safer to plant cherry trees enough to supply both the birds and the family. Much space has been given to the robin, because with us it has proved to be the most useful bird in the garden. The food of the robin has been studied, within the past fifty years, by many investigators. Their conclusions, however, have not always agreed.

Prof. J. W. P. Jenks, Mr. E. A. Samuels, Prof. S. A. Forbes, Mr. F. H. King, Prof. F. E. L. Beal and some others, while varying in their estimates of the robin's value, all regard it as a useful bird: but the investigations of Mr. E. V. Wilcox and Prof. F. S. Webster, published in Bulletin No. 43 of the Ohio Agricultural Experiment Station, present results rather unfavorable to the robin. It is not my intention here to take issue with these gentlemen as to the facts stated in their writings on this subject. I wish merely to call attention to some errors into which investigators who are not familiar with birds' habits are likely to fall, and also to show wherein the observations of Mr. Wilcox do not agree with my own.

He has stated to me in conversation that most of the robins whose stomachs were examined were shot while feeding on the grounds of the experiment station, and mainly during the busy hours of the day. Few birds were shot very early in the morning or towards dusk. Now the robin is very active at such times, and it is then that it has the best opportunity to secure the cut worms, the percentage of which in the stomachs of those examined by Mr. Wilcox is probably too small. All vestiges of cut worms

eaten by the robin at 3 to 4 A.M. will probably have disappeared from the stomach at 6, by reason of the bird's rapid digestion. Most of the robins were shot on the station grounds at a time when they were feeding largely on the small fruits grown there in profusion. Naturally, a larger proportion of cultivated fruit was found in the stomachs than would have been the case had a larger number of the birds examined been shot in other localities and at other times. This seems hardly fair to the species. No stomachs of nestling robins were examined. This seems a capital omission. In our investigations nestlings have appeared to require a very large proportion of insect food, and as they increase in size they require more food than the old birds. A young robin has been known to eat forty-one per cent more than its own weight each day.

Mr. Wilcox failed to find any grubs in the stomachs of robins shot on ground recently plowed, and he accounts for this by the statement that the robin does not follow the plow as closely as the crow blackbird, and that the grubs soon bury themselves in the soil, "hence the failure of the robin to find any." This is entirely contrary to our experience here. We have found the robin to be a much more effective destroyer of the white grub than the crow blackbird, which will wait for the robin to find and dig up grubs, and then quickly snatch them away from its beak. If we were to rely on stomach examinations only, the blackbird might get more credit for finding grubs in the ground than he deserves. Our experience in Massachusetts is corroborated by that of Dr. Roberts of Minneapolis, who finds the robins there much more expert in digging out grubs from lawns than the crow blackbird.

Mr. Wilcox says he has never seen the robin searching for insect food except upon the ground. In Massachusetts, however, the robin occasionally takes caterpillars from the trees. It is quite probable that twenty observers scattered over the county in which Mr. Wilcox made this investigation would have made more or less contradictory reports. It is unsafe to generalize too much from observations made by one man in a single locality. My observations on the

robin are offered with the belief that the statements made are correct so far as my own garden is concerned. A small fruit grower differently situated might consider the robin an enemy. The picture of the robin at the nest shows the eagerness with which the young robins anticipate the coming of their food (Fig. 6).

Next to the robin in usefulness in our garden comes the chipping sparrow. This little bird, which often hops about the dooryard of the farmhouse, picking up crumbs that fall from the doorway, spends much of its time in the garden.

FIG. 6. — Robin with White Grub for her Young.

With us it did no noticeable harm, feeding mainly on insects in the spring and summer, and largely on weed seeds in the fall. It was almost constantly busy along the vegetable rows in early summer. It was especially devoted to the green peas and the beets. Beets are usually more or less infested with a larva which mines the leaf, in some cases destroying many leaves. This insect is not usually a serious pest, as some enemy appears to check its undue increase. Early in the season the beets were attacked by it and were quite seriously infested, but as time went on the number of worms grew less and less. It was noticed that this scarcity

of the beet worms was coincident with the appearance of the chipping sparrows among the plants, and that the longer the birds worked there the fewer beet worms could be found. These sparrows were commonly to be seen going up and down the rows, feeding among the plants in the garden where table beets were grown. Other birds of this species were also observed in the field among the stock beets or mangel wurtzels.

One day, by creeping along the ground between the rows, I was enabled to get very close to a chipping sparrow which was feeding there. It was passing among the plants searching somewhat among the stems, from which it took small insects, but mainly getting its food from the infested leaves. By moving very cautiously, I was able to follow it for a hundred yards along the rows. It could be plainly seen taking something from the leaves. It touched none but the infested leaves. In each case when the bird had passed the leaf was freshly punctured, and the worm was missing. The little bird found it necessary in many cases to use its wings to reach the worm, but never failed to get it. Apparently eleven of these worms were secured in a few minutes, and several other small insects were taken. Having watched these birds through one long summer, I have little doubt that their presence saved the beet crop from destruction, or at least from a serious reduction.

The imported destructive pea louse (*Nectarophora pisi*) having been very prevalent in 1900, we were prepared for its appearance in the spring of 1901. The lice appeared as expected, but failed to increase as heretofore. One morning one of the boys at work in the garden reported that chipping sparrows were eating the pea lice. This proved true, for all through the season and also the next season wherever peas were planted these birds appeared and fed on the lice persistently, day after day, so long as they could be found. A row of late peas about one hundred yards in length became infested with the lice in August. These peas were one-eighth of a mile from where the early peas were planted, and in a locality not ordinarily frequented by the chipping sparrow; but the birds soon found them,

and haunted the vines day after day, until the lice were so reduced in numbers that they did no further injury. It seems probable that this habit of the "chippy" is widespread, for Mr. H. W. Olds and Dr. Judd have both observed it.*

These birds apparently rendered it unnecessary for us to protect our peas from these destructive aphides. How generally they may have effected such a result elsewhere I have no means of knowing. It is quite probable that they have borne a prominent part in reducing the pea louse from a pest of the first class to its present status. These birds fed on the eggs of the parsley butterfly (*Papilio asterias*), taking most of them from the leaves of the celery or parsnip plants, where they are deposited by the insect, usually one in a place. The chipping sparrow also feeds on the young larvæ. The attentions of the "chip birds" are not by any means confined to the garden. They are very useful in the orchard, particularly in the destruction of caterpillars, upon which their young are largely fed. They also feed in the borders of woodlands, along the roadsides and in the open fields. As these birds often raise two broods each season, and their young are nourished almost entirely on insects, their great value to the farmer is unquestioned. In the illustration from Mr. Reed's photographs the parents are seen with their callow brood (Fig. 7). In the lower photograph, the female, having brought a caterpillar too large to be fed whole, is seen to join with the male in dividing it.

The song sparrow is another bird which has done excellent service in the garden. A pair of these birds nested near a ditch at the north side of the garden in 1901, where they confined their attentions principally to the early cabbage patch. Both cabbages and cauliflowers made a rank growth, and by June had so covered the ground that these creeping ground sparrows could readily pass beneath them unobserved. Their habits in this respect are such as to completely baffle the ordinary observer. Finally, after much watching, they were seen to eat the cabbage plant louse

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* Bulletin No. 15, Division of Biological Survey, United States Department of Agriculture, p. 77.

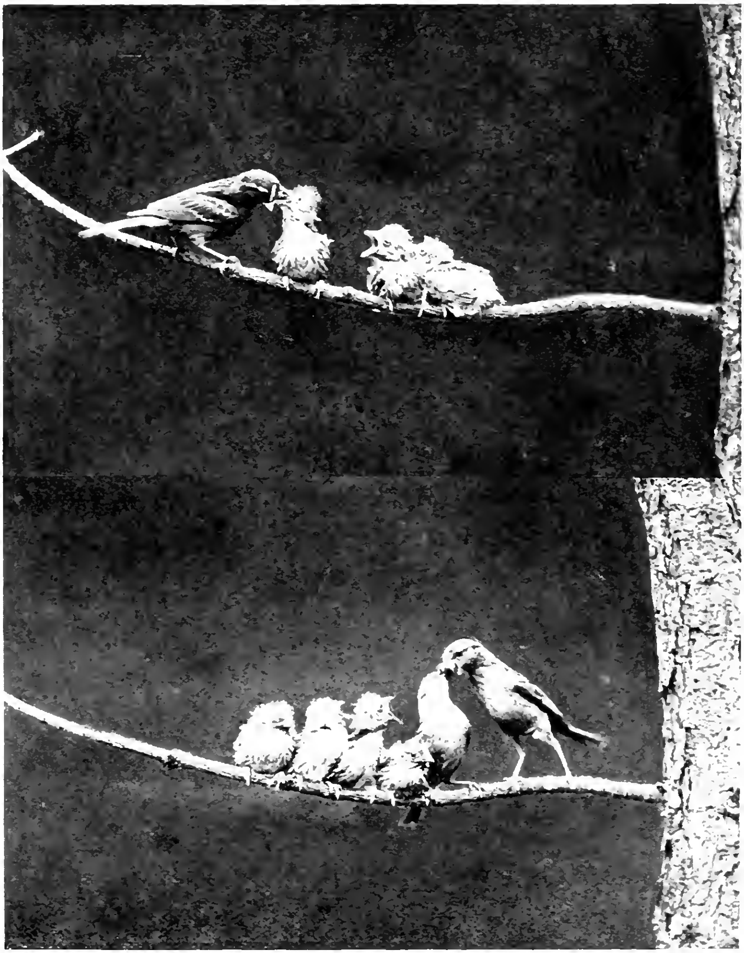

FIG. 7.—Chipping Sparrows feeding their Young. (Copyright by C. A. Reed.)

(*Aphis brassicæ*) and some of the cabbage worms. This pair of birds could be found among the cabbages at almost any hour of the day. They sought their food there almost continually, and they made great havoc with the cabbage insects; but, as there were five different caterpillars on the cabbages, and the birds took much of their food when concealed from view or at a distance from the observer, it is hardly possible to say more than that probably all of them were eaten.

All the cabbage insects were so reduced in number that little injury was done to the heads. No insecticides were used upon the cabbages or cauliflowers, though a few worms were killed by hand at first. They were afterward left to the sparrows. The chipping sparrows also took worms from the cabbages. The song sparrows eat most caterpillars if they are found in the immediate vicinity of their nests. With us they do not go far afield when they can find a sufficiency of food near at hand. They seldom went beyond the cabbage patch, flying from that to the thicket about their home. They feed mainly on or near the ground, and for this reason, perhaps, they search out and destroy many cut worms. They were not seen to take any fruit from the garden, although they have been known to eat strawberries, blackberries and raspberries. This was the only pair of these birds nesting about the garden in 1901. Their young were destroyed, probably by a cat, and possibly the old birds suffered the same fate, as no song sparrows nested there in 1902.

Among the birds which frequented the garden were the catbird and the goldfinch; but, so far as could be seen, these birds contributed little to its welfare. The goldfinches attacked the millet in the field, the sunflowers along the garden border, and ate pieces from the leaves of lettuce and other tender vegetables. They were not seen to eat insects, but they are useful as destroyers of plant lice, caterpillars and other tree-feeding insects. They also destroy weevils; but, so far as could be observed, they were slightly detrimental to the garden. The catbird was never seen to enter the garden except as it went to the strawberry bed after the berries were ripe. Apparently the catbirds went to the

garden for strawberries alone. They were never seen to eat anything else while there, and, as they were about the strawberry bed much of the time while the berries were ripe, they must have eaten as many berries as all the robins, for the robins only took strawberries occasionally. A pan of water was set out near the strawberry bed, that the catbirds might have an opportunity to allay their thirst before reaching the berries. They took no notice of this, as they evidently preferred strawberry juice. If driven away, they would return immediately. They remained about the bed until the berries had been picked, when they left at once, and hardly visited the garden at all for the rest of the summer. Were we to judge the catbird by this experience alone, we must agree with those who consider it a pest. Many people have had somewhat similar experience with it. My experience with it in Worcester, however, was somewhat of a contrast to this more recent acquaintance. There we raised strawberries with little trouble from the catbirds that nested near the garden, and were of considerable service in the destruction of insect pests, notably the white grub. This bird, however, is probably of much less service to the farmer than many others, and is not to be compared with the robin as a destroyer of garden insects.

The vireos, redstarts and warblers, which bred in the woods around the garden, occasionally came inside its limits, but confined their attention mainly to the insects on the fruit trees, so that, so far as could be seen, their presence in the garden had little or no effect on the vegetables. These birds were much of the time engaged in killing caterpillars of many species. They were so assiduous in this that no serious injury was done by caterpillars to any of the trees near by. Even the wild cherry trees, which are ordinarily stripped by the tent caterpillar, were left intact. The vireos are probably among the most efficient caterpillar hunters. The illustration showing the red-eyed vireo feeding her young (Fig. 8) is introduced here to show how the parent bird inserts her bill into the throat of the young, and thrusts the food down into the gullet. This may be a necessary precaution, for living caterpillars some-

Fig. 8.—Red-eyed Vireo feeding Young. (Copyright by C. A. Reed.)

times crawl out of the mouths of the young birds, and escape.

The blackbirds, brown thrushes and towhees kept well away from the house the first season. Dogs, cats and boys evidently had made them distrustful of the neighborhood. A little grain scattered about, in the spring of 1902, brought several blackbirds and a pair of brown thrashers. The blackbirds soon became quite tame, and remained about the place until they retired to the meadow late in May to breed. The brown thrashers came to the dooryard all summer, in search of crumbs and fragments of grain, and finally became quite tame. Neither these birds nor the towhees seemed to be attracted to the garden, although the towhees came into it much during the late summer. These birds are all useful in the garden, provided they can be induced to frequent it. None of them injured anything in it, except that the towhees picked up a few ripe gooseberries. Some of the birds which are known to be conspicuously useful in the garden did not stay with us, although they were occasionally heard singing in the early spring.

Those who have followed me thus far may begin to surmise that for some reason birds were not exceptionally numerous in this locality, so well fitted for their homes; such indeed is the case, and the reason is not far to seek. Birds have been protected here to some extent for years, so far as the encroachments of the gunner are concerned, but their natural enemies have greatly increased in the mean time. All the swallows and most of the bluebirds have been driven away from the neighborhood by the English sparrows. Most of the smaller birds which had survived the attacks of their various enemies failed to breed, for either the eggs or young were destroyed. No doubt this state of things ought sooner to have been remedied; but I desired first to study the influences which diminished the numbers of these useful creatures, so as to be quite certain what means to take for their protection.

My experience here during the past two years, taken in conjunction with the experience of the previous twenty-five years, leads me to believe that the enemies of birds stand

about in the following order, as regards their importance: cats, English sparrows, gunners and boys, crows, jays, hawks, squirrels, snakes, skunks, foxes, weasels and other small mammals. Owls, shrikes, and some other birds may also be named as of varying importance according to circumstances. Dogs eat eggs and kill some nestlings. In this classification of birds' enemies I refer mainly to conditions prevailing in eastern Massachusetts, which is a thickly settled region; in a less thickly settled or more open country, a change in the relative positions of birds' enemies might more nearly approximate the facts.

Properly speaking, man is the greatest enemy of the birds. Cats, dogs and English sparrows have been both introduced and fostered by him. Birds are killed by him for ornamental purposes and for sport, instead of being given that consideration and protection which is their due, and which man can readily afford them. Cats are named first as bird enemies, because they are exceedingly numerous in the vicinity of cities, towns and villages, and because each, in good hunting grounds, will probably destroy about fifty birds each season. I have known a single cat to kill all the nestlings in six nests in one day, which, with two of the old birds struck down while trying to defend their young, made twenty-four birds in all.

No doubt this is exceptional; but few nests are secure from these cruel marauders, except those which are inaccessible, like many of the nests of the Baltimore oriole. Most farmers keep too many cats. The country is infested with vagrant cats. Hounds often "tree" them in the woods far from any house, and their tracks may be seen in every newly fallen snow. Cats are turned out by people who wish to get rid of them. Many are abandoned by city people when going back to town from their summer homes. Some may take to the woods from choice. All this is bad for the birds. Many such cats inhabit the woods and thickets about Wareham, living on birds, mice, squirrels and insects: haunting back yards, poultry coops and barns; stealing any food that may be left in exposed situations; making the raising of chickens a precarious business; and

even killing rabbits, pheasants, partridges and half-grown fowls. Such cats are largely responsible for the fact that many of the ground-breeding and bush-habiting birds in our neighborhood have been killed or driven away. Careful investigation will show a somewhat similar condition in many neighborhoods. For this there is only one remedy, — these cats must be exterminated.

Twenty years ago the English sparrow would have been placed first on the list, but it is not now so serious a menace to our native birds as then. The conditions for its increase are not generally so favorable as they then were, and its enemies are more in the ascendant. It should not be tolerated, however, by any one living in the country who prefers the presence of our many beautiful and far more useful native species. If its presence is tolerated, it is likely to drive out all those native birds that nest in or about buildings or in bird houses. It also annoys many other birds, and drives them from the neighborhood of our homes. I have now driven it out of this neighborhood, but its former presence accounts for the absence of wrens, bluebirds, phœbes and swallows, which no doubt once bred here, and may now be induced to return. The sparrows — according to the testimony of many observers — do not kill the native birds and their young to the extent that they did some years ago; but they often destroy the nests of other birds, and they still persist in following or mobbing birds of other species, and compelling them to move on. If their nests are destroyed and the birds shot whenever occasion offers, the survivors usually learn to keep away.

In speaking of the gunner as an enemy of birds, it may be well to except the honest sportsman, who complies with the law, respects the rights of property and is intelligent enough to know that it is for his own interest to protect all birds from undue or illegal slaughter. We may except also the scientific ornithologist, who kills birds only when necessary to further the interests of science. In the present state of ornithological science, there are very few men who should find it necessary to kill many birds for this purpose. It is the irresponsible gunner — boy or man, who shoots, in sea-

son or out, anything which comes within the range of his gun, from a hen to a chickadee, for sport or practice, as the case may be — who should be suppressed. The trolley cars which flood the country, especially on Sundays and other holidays, with gunners and fishermen from the cities, have increased the danger to the birds from this class of people. A large proportion of these people are foreigners, or of foreign extraction. Since the trolley roads came into Wareham, we have had occasion to warn many of these people away from the premises. Usually when spoken to they have replied in broken English. Many of these foreigners shoot and trap song birds to eat. They are also trapped in considerable numbers for exportation alive. The constables in country towns should be empowered and directed to arrest these trespassing law breakers, and should be allowed half of the fines whenever convictions can be secured. The natural destructive propensities of our own children may readily be controlled by education, by teaching them to take an interest in birds, their songs and habits, and by showing them their usefulness.

Having done what we could to protect the birds about the farm from cats, dogs, gunners, English sparrows and boys, we are still confronted with the undeniable fact that most species of birds about the place are not increasing in numbers, while some of them are decreasing. Some fail to breed at all, while some are entirely absent in the breeding season. The explanation of this lies largely in the fact that under protection the jays increased largely the first year, while the crows are increasing regularly, and frequenting the place more and more. It is to be regretted that, where all birds are protected by man, *birds are the greatest enemies of birds.* I have previously reported * that in the Middlesex Fells reservation near Boston the crows appeared to have increased at the expense of the smaller birds. This region came under my observation in 1891, when the committee in charge of the gypsy moth work was first appointed. From that time until 1900 several observers who were well acquainted with the birds of the region passed

* Agriculture of Massachusetts, 1900, p. 50.

much of their time in these Fells. In 1891 the land was owned mainly by individuals, and was a great resort for gunners. Hares and grouse were rare. Crows and jays were not exceedingly common, and the smaller land birds were found in such numbers as are usual about our cities. Within two years after the Metropolitan Park Commission took the land, and stopped gunning, trapping and snaring by a remarkably efficient system of police protection, hares, grouse, jays and crows became much more numerous, but many of the smaller birds which breed in the Fells decreased somewhat in numbers. Our observers found that the eggs and young of these birds were being destroyed mainly by crows and jays, which were often seen during the breeding season searching the woods for them and destroying them.

Most farmers know the bird-nesting habits of the crow, — how it sneaks about the house and orchard in the early morning hours, stealing eggs and nestlings from the nests of robins and other small birds. Similar habits of the jays are also notorious. Still, it is not so very often that these birds are actually seen in the act of eating the eggs of small birds. Crows may commonly be seen to destroy the eggs of herons or sea birds, when these birds are frightened from their breeding places by the approach of men. In their eagerness to secure the eggs or young before the return of the parents, crows sometimes become quite daring. This trait of their character I have often observed when in heronries or on the rocky islands of the coast, where sea birds breed; but it is far more difficult to catch them in the act of robbing the nests of small birds, which are scattered singly in woods, groves, orchards and undergrowth, where the crow or jay can readily keep in hiding behind the foliage.

When we first occupied the farm in Wareham, two pairs of jays were breeding in the "robin roost," but no crows bred in the woods about the place. Both crows and jays were very shy. Crows seldom came into the "robin roost," nor were they troublesome about the farm. Under such protection as we were able to give, the jays increased so that by January, 1902, there were at least fifteen pairs in

the "robin roost" and about the farmyard. They had become so tame by this time that they would come to our windows to feed. Many other jays, also, finding here a comparatively safe retreat and some food always at hand, made the place their winter quarters. In the mean time, the crows had also increased largely. They bred mainly in the woods of a neighboring farm, but fed much about our place. As time passed and they were not molested, they became more and more bold, taking eggs and chickens from the poultry yards, and cautiously searching among the trees, apparently for eggs and young birds. They did this persistently, but kept their movements so well covered that they would hardly have been noticed except for the cries of the parent birds and their habit of pursuing the crows which came near their nests. A few birds beside the robin and the chickadee were able to raise their broods in 1901, but in 1902 the *chickadees, pine warblers and Maryland yellow-throats were the only birds smaller than a towhee that were known to raise any young.*

Kingbirds, robins, brown thrashers, towhees and birds of this size were able, though much persecuted, to raise some young: but, so far as we could discover, nearly all of the smaller birds, such as warblers, sparrows and vireos, failed to raise any, while several species made no attempt to breed here, but left, presumably for safer quarters. The nests of all these small species were persistently robbed. Most of them never hatched an egg. In some places their eggs were stolen before the full complement was laid. The chipping sparrows in a small apple tree by the house, having lost their first and second set of eggs, built a nest on a branch of a tall pine, only to lose the eggs as before. A pair of vireos changed the location of their nest, with similar results. The ground-breeding birds suffered less. A pair of song sparrows, as before stated, were able to hatch their young. Towhees hatched and reared at least two broods. The nests of the oven birds seemed to escape the marauders, but no young birds were seen later in the woods. No doubt the partial immunity of these ground-breeding birds from the attacks of their bird enemies lies in the fact of the care-

ful concealment of their nests. They are more likely to be found, however, by their four-footed enemies.

Robins, brown thrashers, blackbirds, kingbirds, orioles and jays seemed better able than the smaller birds to protect themselves from the attacks of the common enemy. The jays seldom were able to get a robin's egg if there was a robin within sight. In such a case the alarm was given, and the jay was immediately attacked by robins. Both robins and jays bred all about, and fights between the two species were of daily occurrence. Usually the robins were engaged in driving the jays away from robins' nests, but occasionally the jays seemed to be defending their own nests from the robins. The robins vigorously protested whenever a stealthy crow appeared. Nevertheless, many of the robins' eggs were destroyed. Shells of robins' eggs were found scattered about, showing where the beaks of the destroyers had penetrated them. The present year, 1902, the crows have become so emboldened by their immunity from harm that they have frequented the farm more than ever, so that now even the blue jays find it difficult to raise young. Shells of jays' eggs were found strewn about the farm this year, bearing the familiar beak marks. Young robins and jays have been comparatively scarce. The crows are becoming more bold, and the situation grows worse as time passes. There is no time here to discuss the economic position of the crow, or to enlarge upon the services of the jay as an insect destroyer; the Board has already received my reports on these matters. It is enough to say here that if we wish to protect our smaller birds and increase their numbers, both crow and jay must be kept within bounds.

Our Massachusetts laws do not protect these birds; in this they are wise. The beauty and grace of the jay cannot compensate us for the loss of many other beautiful and useful birds; and, while the crow has its place, and is at times very valuable to the farmer, it can never fill the place about the farmyard and orchard which is now so well filled by the robins, bluebirds, sparrows, warblers, vireos, wrens and thrushes. Crows and jays, like all creatures of omnivorous habits, are sure to become pests wherever they become

unduly numerous. Although the crow has many enemies, there are few crafty or powerful enough to destroy him. The caution and intelligence of the crow are proverbial. Crows, by the strength of their combined numbers, are able to defy even the eagle. They have really only one effective enemy besides man, and that is the great horned owl. Years ago, while studying crow roosts in Worcester County, I found that something was killing crows about these roosts. The remains consisted mainly of feathers, nearly the entire crow having been devoured in each case. After the first fresh snowfall I visited an extensive roost, finding the feathers and a few other remains of a freshly killed crow. At the spot where the crow was borne to the ground were found the strong imprints of the characteristic wing tips of the great horned owl. These owls habitually take crows from their roosts or nests at night. In return, the crows always mob an owl if they can find one in the day time. While we have been proscribing the crow and shooting it at sight, we have been protecting it by shooting every owl that comes within range of our guns. No doubt it is mainly for this reason that crows have multiplied, in spite of this persecution. In our "robin roost" the crows are now in the ascendant; even the jays raised but three broods there last season. One brood was taken by a hawk and one at least by crows before they were fully fledged.*

Hawks are perhaps better fitted than any other creature to pursue and kill other birds, and certain of them may be regarded as among the worst enemies of birds; but they have not been placed first in our list of bird enemies, because they are not especially numerous in the vicinity of the farm. Although all hawks when hungry will seize other birds whenever they can get them, there are only a few that are quick enough to follow and catch other birds in flight. Most of our hawks, therefore, content themselves mainly with picking up such insects, small mammals, reptiles and frogs as they can easily get, and such birds as they are able to catch unawares. The Cooper's hawk, sharp-

* Crows are sometimes attacked by a contagious disease, either identical with or similar to the roup of poultry. See "The Auk," Vol. XX, p. 57.

shinned hawk and duck hawk, which are among the greatest enemies of small birds, are not common about the farm at present, although the sharp-shinned hawk is occasionally seen. There is really but one hawk, in the neighborhood, that kills many birds or chickens, and that is the marsh hawk, which is now usually regarded as the most useful of all hawks.

This hawk is frequently held up as a model by popular writers on bird protection. Such expressions as, "it never touches a chicken," and "seldom kills birds," have been frequently used. The truth of the matter is, that a hungry marsh hawk will take a chicken or a bird at any time when a good chance presents itself. I have known the marsh hawk to kill snipe, song sparrows, a domestic pigeon, young blue jays and many chickens. The bird is often followed by the blackbirds, which indicates that their nests have been robbed by it. All along the south-eastern shore of Massachusetts from Dartmouth to Plymouth this bird is recognized as a chicken thief. It will glide into the barn-yard, seize a young chicken and bear it away to a tree in the woods or low spot of ground, where nothing will remain to tell the tale but the scattered feathers. Well knowing the value of the marsh hawk as a mouser, I was, for some years, loath to believe the stories told by farmers and poultrymen of its ravages in the poultry yard; but during the past two years I have seen these birds strike and carry off chickens both in the woods and in the open. Having lost about forty chickens, the shot gun was brought into requisition, and but two more were lost that season. The marsh hawk could not kill chickens when half grown, as the birds were then strong enough to escape; but small chickens are not safe from this bird unless they can be kept shut up. These birds beat over the meadows and sweep through patches of woodland, snatching young birds from their nests and flying away pursued by the screaming parents. There is little doubt, however, that this hawk, so long as it confines itself to its usual habitat in the fields and meadows, is among the most useful of our native birds, for there its prey consists largely of field mice and other small mammals which are believed to be mainly injurious.

The only snake that has been seen to kill birds in this locality is the black snake, and as these reptiles are not very common, their depredations are not very serious. This snake devours the young of ground-breeding birds, and probably the eggs also. It often climbs bushes and trees, and, coiling itself around the nests of robins, thrashers or catbirds, devours the young in the most deliberate fashion, the old birds in the mean time fluttering about in distress, or doing battle with the enemy as best they may. Occasionally in the summer the birds may be seen crowding to a certain tree or thicket and uttering cries of distress. This is always the signal for some one to go to their relief, and nearly always a cat or a snake is found to be the cause of the trouble. These snakes often catch fully fledged young, when, or soon after, they leave the nest. We always kill these snakes at sight.

Skunks are so useful in killing insects that the comparatively few birds' eggs they eat cannot count heavily against them. Weasels are not plentiful enough in the neighborhood seriously to affect bird life. To what extent dogs and foxes destroy the eggs and young of ground birds can only be conjectured. The smaller owls and the shrikes or butcher birds kill some small birds; but, as they kill mice and English sparrows, the good they accomplish far overbalances the harm done.

I approach the name of the squirrel with some reluctance, for squirrels are general favorites among those who appreciate the beauties of nature. Their grace and beauty, their sprightly and companionable ways, and their tendency to confide in us when allowed to do so, have endeared them to many a lonely soul. But the farmer considers all squirrels pests, and rightly so. There is no animal which can do the farmer so much injury in proportion to its size as the squirrel. Squirrels not only carry off enormous quantities of corn, but they destroy far more strawberries than birds do, and they ruin ten times as many pears, peaches and grapes as they can possibly make use of. The fruit is bitten, and then thrown to the ground to rot. They will go over planted ground and dig up the seed of squashes. They will

pull or dig up the young corn about as fast as a crow. They are the very incarnation of mischief. The red squirrel is perhaps the more mischievous, but the gray squirrel is not far behind it. It may be this spirit of mischief that impels them to break up the nests of birds. That they do this is not open to doubt. A pair of gray squirrels was seen in the "robin roost" in July, 1900. They were not molested, and soon became so confiding that they built a nest in a dove cote in the barn the ensuing winter, incidentally driving out all the pigeons, who left never to return.

Two broods of young ones were raised in the barn; then nest building was begun in the pines. The squirrels increased rapidly, and in 1902 six or eight pairs were breeding in the vicinity. Red squirrels were also quite plentiful. The gray squirrels made frequent attempts on the nests of both jays and robins; but, as both birds always joined forces to repel the common enemy, the squirrels were frequently driven off. They were not seen to accomplish their object, but no doubt they did so in some cases. The actions of the birds told that they well realized the danger, and were determined to conquer or die. The gray squirrels are not so active as the reds; but either of them are likely, when opportunity offers, to eat birds' eggs or kill the young. Mr. F. H. Mosher writes me from Hyde Park, N. Y., that the squirrels there upset birds' nests quite wantonly; also that they bite off the heads of young birds and throw the bodies to the ground. It is difficult to judge how universal such habits are among squirrels, but where they are observed, it is safest to kill the squirrels at once.

I have dwelt at some length on the habits of the creatures that contribute to restrain the increase of birds, that we may fully realize the importance of protecting birds against these enemies. If the smaller birds are to resume even their normal numbers, a different policy must be pursued from that heretofore adopted. Bird protection means something more than the ordinary interpretation of the term. If we wish to protect the smaller birds, we must banish or destroy their natural enemies. How this is to be done, and just what its effect will be if it succeeds, is the next

subject for inquiry. These questions can only be answered by the experience of the future.

The most important conclusion that has been confirmed by these two years of bird study is that the *Corvidæ* (crows and jays) are very largely responsible for the decrease of the smaller birds. I am well aware that some investigators will not agree with this conclusion: but it has been forced upon me by the experience of thirty years and the corroborative observations of the last two years. No one can doubt that in the great plan of nature these birds fill well their place. Their usefulness as insect destroyers is well known: but where they become too numerous, their supply of insect food is soon so limited that they must turn to other sources for a good part of their animal food; then smaller birds and young chickens suffer. Could the crows and jays hold in check those insects that, in consequence of the destruction of small birds, are allowed to increase, then the destructive propensities of the crow family need not be viewed with alarm. That they can do this is improbable. By protection, we have made it possible for these birds to increase. We must remove this protection, or remove the surplus *Corvidæ*.

Domestic Fowls as Insect Destroyers.

Common fowls, if rightly handled, may be made most useful as insect destroyers in garden and field. We utilize the services of young chicks in the garden by keeping the mother hens confined there in small coops along the borders. Then each brood of little chicks can have the run of that part of the garden nearest the coop, as well as the grass near by. Young chicks, kept in this way, soon learn to eat such garden pests as are turned up by the plow or other garden implements. They are fond of small caterpillars, maggots and cabbage plant lice, and some of them will learn to eat the small larvæ of the potato beetles. With us they have not learned to eat the melon plant lice or the squash insects. But few birds of any kind have been seen to eat these pests.

Young chicks may be safely kept in gardens until five

or six weeks old, when they will begin to eat the vegetables. Ducklings are useful, but more destructive than chicks. They are very fond of radishes, and will devour them when very small. All this is not new to many farmers, but not all are aware that large chickens or even full-grown fowls sometimes may be used to check insect invasions in the garden. If hens are kept well supplied with green food, grain and water, they may be turned into the garden occasionally, to follow plow, cultivator or wheel hoe. They soon learn that in following such implements they will find angle worms, cut worms, wire worms and other insect food, and they will seldom do much injury to the garden while so engaged. If they have not been liberally supplied with such grain, green food and water as they need, they will attack both vegetables and fruits. Most farmers know that fowls will clear fields infested with grasshoppers, crickets and army worms. Ducks are particularly fond of army worms, and a flock of five hundred ducks ought to be able to stop the progress of these destructive pests on any farm. It is said that young turkeys may be taught to eat the larva of the Colorado potato beetle, and will clear the vines of this pest. Some ducks eat this insect. Mr. E. H. Kern of Mankato, Kan., writes that his ducks cleared the bugs from the potato field. So far as his experience goes, all ducks like these insects, and seem to grow fat by feeding on them.*

Chickens will destroy the maggots of the common house fly, and thus prevent the increase of this pest. Dr. Howard, chief entomologist of the United States Department of Agriculture, tells us that these flies breed chiefly in horse manure, and also in human excreta.† He tells how to prevent their increase in vaults and manure piles by the use of chloride of lime. We find that a few chickens confined where they can scratch over the stable manure are effective, and less expensive than the chloride of lime. They will spend much time scratching and digging over this manure, looking for partially digested grain, seeds and maggots.

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* Insect Life, Vol. III., p. 398.

† Circular No. 35, second series, Division of Entomology, United States Department of Agriculture.

This scratching fines up and dries out the manure, rendering it an unfit breeding place for flies; but if any maggots appear, they are soon eaten.

While there are some insect pests that are not eaten to any extent by either wild birds or poultry, most of them may be controlled by one or the other. Young chickens, and even mature fowls, eat a great many weed seeds. Fowls may be used to take the place, in a measure, of the wild turkey, partridge, prairie chicken or heath hen, wild pigeon and quail, once plentiful in Massachusetts, but now in one case exterminated and in the others altogether too rare. The man who raises one thousand chickens, five hundred ducks and a few turkeys each year, has under control a police force sufficient to check any invasion of such grass, grain or garden insects as poultry will eat; but we must still depend largely on the wild birds to hold the tree-inhabiting insects in check.

Secretary Stockwell. Have you ever known the gray squirrel to steal from the birds their eggs?

Mr. Forbush. The red squirrel is quite a thief, but the gray squirrel has a better reputation. I have known the gray to take from a bird's nest one or two eggs, or even all. I notice the birds are very anxious to keep squirrels away from their nests, as the squirrel is considered an enemy.

Secretary Stockwell. I have taken so much pleasure in noticing the enjoyment which the gray squirrel seems to take in his life with good people that I am sorry to hear this of him. I had supposed the gray squirrel did not attack birds' nests, while the red squirrel is a most pernicious pest; and whenever I see a red squirrel, my first impulse is to get my gun and shoot him, because he is such a merciless destroyer of the birds' eggs. I have gotten out of my carriage when riding to stone this thief away from the robins' nests near the roadside. At a largely attended meeting of farmers from all parts of the State the question was asked: Does the gray squirrel attack birds' nests? Not one knew this for a fact, and nearly all testified to his good character.

The lecturer has brought prominently to your notice the value of these birds to us as farmers, and it is something that cannot be computed. We could imagine the value of these birds, if they were taken away for one or two years, for we should have nothing to be thankful for at this season of the year, so great is their help.

We encourage birds at our home. We have a great many of them, and we keep them there as well as we can. A few years ago I was just recovering from a sickness, and there came a very severe storm; snow and cold were biting, and the birds took refuge in an arbor vitæ hedge I had. They remained there during the night, and in the morning they would go to the garden, where my careless husbandry left seeds, and they gathered them and came back for protection in that hedge: and it was pleasant for me to look out upon those birds and see they were being cared for during that storm.

This year there were one or two instances on the farm that may be interesting. In mowing one of my fields near the house we mowed with the machine and raked with the machine, and then when we came to gather up the hay we came upon a nest of larks nearly ready to fly. The horses had travelled over the ground, the mower had cut the grass over their little heads, the rake had followed and dumped the windrows on the nest, and yet they were safe. We protected them, — put a mark over them, so they would not be disturbed. They were very nearly ready to fly, and after a few days went away. We had another nest almost in sight of the windows of our house. There was a quail sitting on her nest with sixteen little eggs under her, and she sat there as pleasantly while we mowed over her or around her; and she sat and watched us with as much confidence as though we were her friends and we had known her all our days. I watched, and perhaps ten days later she went off with her sixteen birds, and I saw no more of her until I found she was feeding her young in a corn field, and there she brought up her young ones. I left my office one Saturday, and arrived home about 4 o'clock. My men were husking corn, and those quail had been right

around with the men in the corn field, perfectly at home, until during the noon recess the hunters had found them, and had been chasing the poor things all the afternoon. With the first sound of the gun I went for the hunters and told them to leave my farm, but those quail did not come back again into the field; they had had a lesson that drove them away. Why should we not protect these birds? Why should we allow the hunters to kill them for the sake of sport, as they call it, — to kill these beautiful little birds that are such a joy and such a help to us? I hope that we shall protect them for the sake of the love we have for the birds that are such an amount of comfort to us, so delightful, and that give us so much enjoyment. What would the world be without birds? I would go further, and protect all birds that are not injurious, because they were given to us that they might add life and light to the landscape, and be a joy to us. They have a right to life for the good they do, and should be protected from the hunter who ruthlessly murders them, and does it for sport.

I want to give an illustration of the intelligence of birds, as also of their friendliness. Upon the post of our piazza a pair of phœbe birds have nested for several years. They look in upon us in our sitting room, and seem to enjoy our life and our domestic arrangements as we do theirs; and I cannot express the delight their presence and habits have been to us. The feeding of the young by both male and female bird; the quick catching of the fly, and return; the little mouths always thrust up, open and hungry, are object lessons of the value of these birds as insect destroyers. Only one suggestion as to intelligence. These little birds have come there year after year for seven years in succession. They go away for the winter, and return to the old nest and seem to enjoy their surroundings year after year. Now, will the lecturer please give us some illustration, of which he has so many, of the amount of insects the mother bird supplies to her young? It would give us a better idea of bird value to the farmers of Massachusetts.

Mr. Forbush. The vireo we have found to carry food to her young over three hundred times in the course of a day,

and the wrens more than twice that number of times. Some birds when their young are small will go one hundred and twenty-five to one hundred and thirty times, and nearly every time they carry food, and sometimes from one to twelve worms at a time. Professor Wood says that the daily food of a young robin is equal to an earthworm fourteen feet long in one day; and one other authority shows that the young robin eats more than its own weight in worms daily, and that it requires more than one-half its own weight. If a man were to eat sixty-seven feet of sausage, nine inches in circumference, he would eat in about the same proportion.

Mr. ——. The kingbird stays around our bee hives, and keeps us from getting an increase from the honey product, and eats our bees.

Mr. Forbush. It has been said that the kingbird does not eat any bees but the drones. They prefer the drones, because they cannot sting. Now, there is a little habit in favor of the king bird that the bee raisers do not always know of. This bird eats the robber fly, and this is one of the worst enemies of the bee hive. The kingbird is a great destroyer of flies of all kinds; that is one reason why he is useful. And the kingbird drives away from the region of the farm the crow, hawk, eagle and all birds which molest the poultry. Still, we must admit that the kingbird does eat a good many bees.

Mr. N. B. Baker (of Savoy). On the mountain our corn started very well, but the crows actually ate up all of it. I wish they would shoot them all. We have no use for them.

The Chair. I had a little experience the last season, after having hobnobbed with our friend the lecturer. I thought I would try to have some birds about my premises in the city, and I put up five boxes, one on the telephone pole and the other four on the barn. Early in the season some English sparrows undertook to appropriate the boxes. They would light, but they did not make any headway, and later the bluebirds took possession of one. We had three broods of bluebirds and two or three tree swallows, and we enjoyed it exceedingly.

Prof. Wm. P. Brooks (of Amherst). I am sure the lecturer knows perfectly well that the crow does a great deal of good. So much has been said against the crow, that many feel that they agree with Mr. Baker as to what should be done with it. I don't know but they are right. I don't know but I should also do as they would do. But I learned something in Germany that interested me about crows. A professor was talking about sugar beets; he said they did not all usually come up, and it was necessary to transplant some of them. He noticed that part of the plants would become wilted. The crows would come along and pull up all these beets that the farmers set out with so much care; and the farmers thought, with Mr. Baker, that was a dreadful thing. Finally, some one who knew a little more about crows began to study the question, and he came to the conclusion that the reason was that the crows thought there was a white grub at the root, and the reason of that was because their experience had shown them that whenever beets in the field wilted, it was usually because there was a worm at the root, and in taking the transplanting into their philosophy they thought there was a worm there. These white grubs are very troublesome now in the beet fields; and the German farmer believes that, although the crow does do a great deal of harm, it is one of the best friends the farmer has, and the beet culture would be almost impossible but for the great good the crow does him by digging up grubs; and now when he transplants he pinches off nearly all the leaves, and so the crows do not dig them up.

Mr. Forbush. I don't want to say very much about the crow. My point in regard to the crow is this. I am on record in the publications of this Board at some length. The conclusion there is, that it paid the farmer to encourage the crow, if the farmer did not let him get the best of the bargain. A few crows are not so much trouble to the birds or to corn as more. When they get numerous their great appetites compel them to turn to food that they neglected when not so numerous. There is only just about so much good they can do, anyway. I should hold the crow in check.

Mr. H. A. Turner (of Norwell). I think crows do considerable damage besides pulling up corn. They carry off lots of chickens. They come down and pick off a good many more chickens than the hawks do, and it seems to me that they are a pest. They are very numerous down our way.

The Chair. Your duty is plain.

Mr. A. M. Lyman (of Montague). I have found coal tar is a good remedy to use. For five cents you can buy enough coal tar for five acres of land.

The Chair. Did I understand the lecturer to condemn the blue jay?

Mr. Forbush. I should put the blue jay about where I put the crow. There are many creatures which in ordinary circumstances are not pests, who will become pests if they increase too fast; it is so with the crow and the blue jay.

The Chair. How about the crow blackbirds?

Mr. Forbush. The crow blackbird is not so destructive to young birds and eggs, as are the jay and crow. It has some bad habits, but I think also good ones, and I should rather be in favor of leaving it where it is. I think our laws are very good; they allow a man to shoot the crow blackbird if he wants to, but if he wants to protect them he may.

SECOND DAY.

The meeting was called to order at 10.30 o'clock by First Vice-President Sessions, who said: The lecture of the morning will be by Mr. George H. Ellis, upon "The need and economic value of improvement in dairy stock."

Mr. Ellis has had a very large experience, as large as any man in the State of Massachusetts, now living, in regard to this matter, and his opinions carry great weight.

THE NEED AND ECONOMIC VALUE OF IMPROVEMENT IN DAIRY STOCK.

BY GEO. H. ELLIS, WEST NEWTON.

After I had accepted an invitation to speak before this body upon "The need and economic value of improvement in dairy stock," it occurred to me to consult again the last report of the secretary of this Board, to refresh my memory as to what had been said upon the subject. I found Ex-Governor Hoard's lecture on "Dairy economics," Dr. Twitchell's "Lesson in economics," and Professor Cooley's "Selection and improvement of the dairy herd," — three admirable papers, covering almost every point which it will be possible for me to touch upon, and better than I can hope to do.

But, as most of these papers treat the matter in the abstract, I decided, at the risk of seeming personal, to use actual figures from our own experience at Wauwinet farm, which have helped us to realize the need and the value of such improvement.

Our records show at glance the number of pounds of milk given by each cow for the past six or seven years, and we are therefore able to make comparisons, not only between our own herd and other herds, but between the different animals in our own herd.

What is the average production of the average herd? Authorities pretty generally agree that in this State it is considerably less than 4,000 pounds per cow; but as this is probably an estimate only, we will consult figures from carefully prepared statistics in Hoard's "Dairyman," obtained in some of the best dairy sections in New York State.

Mr. W. H. Jenkins, a recognized authority, furnished in the "Dairyman" for November 14, a table showing the production of 80 herds in Onondaga County, containing 852 head, with an average yearly yield of almost exactly 4,000 pounds; but one-half of these herds were fed largely on alfalfa as roughage, and therein had an advantage over us in New England, where as yet we have not made a success in growing this most valuable of clovers. The 40 herds not fed alfalfa averaged only 3,689 pounds per cow.

In the "Dairyman" for November 21, Mr. H. H. Lyon, who is conducting an investigation at the Bainbridge creamery, prints statistics from 10 herds, containing 186 cows, with an average of 3,648 pounds per cow; and this furnishes a fairer basis for comparison, as he states the amount of grain fed, which averages only about 2 pounds per day less than that given to our own cows. Few, however, of these herds are fed ensilage, and therein we have an advantage.

For the purpose of this comparison, we will take the figures of our own herd for the year ending January, 1900, partly because we can make an easier division, and partly because the figures for the two succeeding years show a slight falling off from those of that year. The average of all the 160 cows in milk, or which should have been in milk for that full year, including all heifers and all aborters, was 6,003 pounds of milk, averaging, in all of the several tests made, a little better than 5 per cent butter fat. There is a difference, then, of 2,355 pounds between the average of the 10 herds reported by Mr. Lyon and the average of our own herd, which, at 1¼ cents per pound, would make $29.43 per cow.

But the difference is not less pronounced if we use only figures from our own herd; for, of the 160 cows averaging 6,003 pounds, 79, or practically one-half, averaged 7,223 pounds, while the remaining 81 averaged only 4,813 pounds, — a difference of 2,410 pounds at 1¼ cents per pound, making $30.12 as the actual cash value of the difference in product, — not of individual cows, but of the best half and the poorest half of our own herd, figured at a

fair price at the farm; and yet the average of our poorest half is better by nearly 1,000 pounds than the other averages quoted.

Now, what is the difference in actual value between the animals classified as the "better" and the "poorer half" of our own herd? It is difficult to make an arbitrary figure, because several things enter into the computation which cannot be accurately estimated; among others, the greater liability of the larger producer to milk fever, garget and other troubles, that may take her out of our profitable list. But, assuming the average producing years to be five, the cash value of this difference in product is $150.60. Suppose we pay $50 more for the better than for the poorer cow, and allow 6 per cent compound interest on this additional sum, — she would have cost us $66.90 more at the end of five years than the poorer cow, and we would still be $83.70 to the good; and yet who of us, in buying, will allow that there can be $50 difference between a good cow and an extra good one?

But how are we to obtain these so-called extra good cows? The only satisfactory way I know is to raise them.

Were dealers or sellers able, as all should be, to state just the amount and quality of milk a cow had given for a full year or for a series of years, the problem would be a different one. At a meeting of Jersey cattle breeders some years since, a man asked, in my presence, of another who had a national reputation as a breeder of fine cattle, "What do you consider the best points in buying a cow?" "I think the milk pail is a pretty good point," said he. And so it is; but do not be deceived by the cow that gives an immense quantity when fresh. The year's product is the only thing that counts when you balance the year's account.

As to the relative value of cows raised or bought, I have obtained from our books some figures that may prove interesting.

In 1901 we bought in Brighton market, on September 10 and 17, 22 cows, all grade Jerseys, and all bought, I have no hesitation in saying (as I did not buy them myself), with good judgment. They were all fresh and all promis-

ing, costing an average of $54.90 each. Our milk scales soon told us that 4 of them were unprofitable, and as soon as seemed desirable we sold them for beef, leaving 18 cows, at an average cost (allowing for the loss on 4 sold) of $61.50. These cows presumably calved in August, 1901, and I find by our records they average to be due again in December, 1902.

We had 34 heifers born between Aug. 1, 1898, and April 30, 1899, which came fresh with first calves in 1901; and it so happened that they averaged to calve in August, and they also average to be due again in December, so we have here a good basis for comparison.

The 18 cows averaged, for the eight months from Jan. 1 to Aug. 1, 1902, 4,048 pounds of milk: the 34 heifers averaged for the same time 4,431 pounds of milk, — nearly 10 per cent more than the cows. And let it be understood these were not selected heifers. Included in this list is every heifer on the farm that came fresh for the first time during the year 1901, whether properly calving or aborting, — and 4 or 5 of them did abort. Six of them had their second calves during the time covered by these figures; but eliminating them would not change the result, as all averages would remain the same. The average age of these heifers at calving was 31 months, the youngest to come fresh aborting at 21 months, and the oldest being 38 months. They were all by our own thoroughbred Jersey bulls, and most of them out of grade cows; those out of our thoroughbreds showing little, if any, above the average, either as to quantity or quality of milk. Many of them were, of course, out of cows of our own raising, they being by our bulls out of grade cows.

Seven of the smallest milkers (mostly aborters) were not brought from Barre to the home farm, and were not therefore tested for butter fat; but the average of the other 27 was 5.05 per cent.

As to the cost of raising these heifers, I am unable to give exact figures. Realizing the necessity for raising our own stock, and appreciating the fact that to do this economically on a large scale it must be done in a good

grazing country, we have established farms in Barre in Worcester County, whose hill pastures are hard to equal; but this experiment has not been carried far enough to give results, except in one particular. We lease one farm of about 200 acres, having on it a large barn, the floors of which we utilized with pens holding from 3 to 5 yearlings each: and on the product of this farm we carried last year 85 heifers and 2 bulls, at a cost practically as follows: —

Rent of farm,	$500 00
Cost of manuring, plowing, planting, cultivating and putting in silo 11 acres of corn,	220 00
Commercial fertilizer,	42 00
Putting in hay,	150 00
Two-thirds wages of man 200 days in winter care,	150 00
One-fifth cost of silo,	50 00
Additional pasture,	100 00
Incidentals, say,	63 50
Total,	$1,275 50

or $15 each for the 85 head, including cost of carrying 2 bulls. The items for incidentals may be a trifle small, but we had between 12 and 15 tons of hay remaining in the barn in the spring, of which I have made no account, and which would more than offset this.

Taking this as cost of carrying for the year, from 1 to 2 years old, what is the cost of carrying for the first year, and for the additional 7 months required to bring them to 31 months, — the average age of calving? As to this, I have as yet no definite figures. The first year is, of course, most expensive, involving, as it does, more labor, and cost of milk (fresh and skimmed) and grain, to bring them up to six months old; but it is safe to say that our 34 heifers would cost us at 31 months of age not more than $40 each, against $61.50 for the cows bought.

Among the heifers are probably 5 or 6 which we shall not consider good enough to keep, but this percentage is no greater than with the cows bought; and in the comparison of figures above made I have included, as before stated, the product of every one, including those which are unprofitable, thus materially reducing the average.

Among these 18 cows, the figures of which are here included, are some good ones as well as some poor ones. There are two that gave over 10,000 pounds of milk each in ten days less than a year, between the 10th of September, 1901, and the 1st of September, 1902. The test of one of those giving over 10,000 pounds was 4.45 per cent; the test of the other, 4.62 per cent. They gave a very large quantity of milk, but not so rich as our average.

Now, our breeding is not merely to decrease the first cost, but to improve the herd for production; and it goes without saying that whatever the purpose for which we are keeping our cows, thoroughbred bulls should be used, of the breed best suited for the purpose. In our case we took the Jersey, for the very plain reason that we are located in a Jersey city. Newton was essentially a Jersey town in the old days, and very many were still kept there when we began this plan of supplying milk in the way we are doing; and in establishing our business, in not a few cases, we bought from proprietors their Jersey cows. Jersey milk was what these people wanted and were willing to pay for, and we have learned to supply what is wanted. If we were making it for contractors, we should not make Jersey milk, but as large a quantity of milk as we could, and maintain the standard, and we should feel that therein we had fulfilled our obligations.

In raising our calves we try to reduce the cost as far as possible; but that is not the main thing. The main thing is to keep them growing, to get strength, to get size and constitution. Our ration for our calves is sweet milk for some days; then we introduce skim milk with linseed meal, and keep before them ground oats and rowen, or good hay. When they are from two to three months old (if it is in summer) they are turned out to pasture; but the skim milk and linseed meal, and for a time some ground oats, are continued. We have raised some very good calves on very little milk, and some included in this record were so raised, using oatmeal gruel in place of skim milk. Where one can have skim milk, I should not advise gruel.

In the leased farm referred to we have not an ideal place; it has an old-fashioned barn, and we have turned all the lower floor into pens. Naturally, it is rather dark.

I hope in the near future to build entirely different barns or sheds in which to winter all our young stock. They will be long, low, one-story affairs, divided into sections, say about 12 feet square, in each of which I would keep 4 or 5 heifers. The building would run east and west, giving southerly exposure, and each section or pen would have plenty of windows, including one in roof, and would open into an outside yard. The doors between pen and yard would never be closed, except in extremely cold or stormy weather. I have used this plan with bulls with great satisfaction, and am confident of its successful use in producing healthy, rugged stock.

If outdoor air is so essential in curing tuberculosis in human beings, as many of our best physicians now claim, it must be equally good in guarding against it, whether in men or animals. Undoubtedly the cost of raising will be somewhat increased, but as undoubtedly the results will warrant the expense.

The tendency with too many farmers has been to go from the old barn (with which we were so familiar in days gone by, and through which the wind and snow had free range) to close, unventilated quarters, in which I believe it is impossible to make wholesome milk. Sunlight and good ventilation, however obtained, are essential factors, and so I believe is exercise. I am not in sympathy with the plan, so warmly advocated in some quarters, of leaving cows in the stanchions from fall to spring. It may result in temporary increase of milk yield, but must be at the expense of constitution, if long continued. I would give all cows some out-of-door exercise in all but the stormiest weather. If possible to have a yard or lane so arranged that the cattle could be driven about to the extent of a mile or two every day, I would ask no better arrangement. In the latest barn we built in Newton are 92 pens, each 7 by 9 feet, in which our cows are kept without tying, thus giving opportunity for a good deal of exercise; but, even so, I

much prefer that they should be driven out of doors every day, except in stormy weather.

People living in our cities are realizing more and more the need of returning to natural conditions for continued health. It should be no less needful with cattle. Feeding our own cows entirely in the barn, as we do at the home farm, we plan to give them a vacation of two or three months at the Barre farm, when dry or nearly so. If in summer, as is the case with a large proportion of them, this time is spent in pasture, and we believe this tends to improve constitution in both cow and calf.

We believe in liberal, but not high, feeding. Our winter daily ration at the home farm consists of 30 to 40 pounds of ensilage, 8 to 12 pounds of grain, and all the clover or clover-mixed hay the cows will eat, usually 7 to 10 pounds each. In summer, forage crops take the place of ensilage to a large extent, though the past year we fed some ensilage every day until green sweet corn was available.

Our grain mixture at present time is 1,150 pounds bran, 850 pounds corn meal, 450 pounds middlings and 400 pounds cotton-seed meal: this quantity supplying feed for two days for 143 cows. Ordinarily we do not feed corn meal, but the poor quality of ensilage this year necessitates its use.

We vary this mixture from time to time as the conditions of the grain market and the conditions of our other feed make it seem desirable to do so.

We have experimented with alfalfa to a limited extent, having brought some 30 tons from Kansas and Nebraska, and we find the value to be about one-third more than clover hay. We have made several attempts to raise it, but have not yet succeeded in obtaining and holding a good catch. We do not, however, propose to give it up without further trial, because of its high feeding value, as indicated above, and the fact that it is practically a perennial, having in this respect a great advantage over red clover.

Question. Do you warm the water for your cows?

Mr. Ellis. No, sir: but water is before our cows all

the time. If we were watering once or twice a day, I should want to warm the water.

Dr. J. B. LINDSEY (of Amherst). Will the lecturer add a word to his opinion of how the average cows are kept on the average farm in Massachusetts, and how, in his judgment, they can be improved? That is a subject I believe should be especially dwelt upon. I believe we are behind the times in our methods of producing dairy stock.

Mr. ELLIS. I thought the statistics quoted spoke pretty loudly. A difference of 50 per cent between good cows and poor ones should answer that. We are answering the question of how to improve in our own way by raising our best calves by pure-bred bulls, and these bulls are bought with reference to the purpose. We don't want to use Professor Sanborn's scrub bulls, — I am as much opposed to scrub registered stock as he is; but in our case we want large production as well as rich milk. We therefore breed our pure-bred and grade cows to registered bulls of large milking strains.

QUESTION. How about getting rid of the poor ones?

Mr. ELLIS. It takes sand to get rid of them: and yet, watch your figures and you will find you have missed it if you have not used sand.

Prof. F. S. COOLEY (of Amherst). How much milk or butter must a cow produce in a year to be profitable?

Mr. ELLIS. That depends upon what it costs to keep her. Really, it depends very materially upon two things, — the cost of keeping and the price obtained for milk.

Professor COOLEY. I observe that the lecturer has some idea of what the minimum product of a cow should be, and below which she cannot fall without being sold.

Mr. ELLIS. My sand runs out once in a while, and I do not sell a cow when I know I ought to. We ought not to keep a cow that gives less than 5,000 pounds of milk.

Professor COOLEY. That answers the question. Now, what is the difference in value, in your opinion, between a cow that will produce 3,000 pounds of milk and one that will produce 6,000 or 8,000 pounds?

Mr. ELLIS. Not allowing for the extra chance for loss,

—and there is a little extra chance,—you are running a greater risk with the better cow. There is no question but what farmers could better pay $100 to $150 for a 6,000-pound cow than buy the average 3,000-pound cow at going prices.

Prof. J. W. SANBORN (of Gilmanton, N. H.). I am at the other extreme from my friend the lecturer. I am out in the country, four miles from any railroad. We make milk for the Boston market at about 2½ cents. I have adopted the practice of selling any cow that won't make 300 pounds of butter fat in a year.

Hon. S. A. HICKOX (of Williamstown). I find that it is a very difficult thing to get a herd up to a point of excellence; this year they may do exceedingly well, but may not do so well next year. I cannot account for it. We find there are a great many more crooked sticks than straight ones. We believe in good cows, but it is a very difficult thing to get them. We are willing to pay the price for them. I would like to know how to weed out or get and keep a herd up to the point of excellence mentioned,—6,000 pounds.

Mr. ELLIS. You have got to breed them. We don't discard a cow that does not give us a certain amount of milk at once; we give her an opportunity to come up to the point.

Mr. HICKOX. How much grain do you give the first year to the heifers?

Mr. ELLIS. That depends. We should give a larger quantity to the heifer giving a large quantity of milk. I will ask my superintendent, Mr. Van Norman, to give his figures. I should say from 6 to 8 pounds, so long as she was in pretty full milk.

Mr. VAN NORMAN. I will say in regard to that, we have no rule. The herdsmen are instructed to give that which they need. With a heifer dropping a calf at twenty-four months old, we don't pay much attention to the amount of grain, if she makes use of it for growth or milk. You must bear in mind that a heifer must have food enough to take care of herself, so she may grow and provide milk.

Individuals differ, and differ so materially that it is impossible to give a specific amount.

Mr. Ellis. We have almost never had a heifer injured by overfeeding.

Question. What do your cows average a day per cow, — how many quarts?

Mr. Ellis. With 6,000 pounds, they would average 7.31 quarts per day. Our basis for figuring is not 2⅙ pounds, which is ordinarily taken. Our records show us every day the barn weights of our milk, and we have also the exact measurement; and our average is just 2¼ pounds barn weight to the measured quart, and on that basis it would give 7.31.

Question. Will that average for three years?

Mr. Ellis. It might not for individual cows; it would for the herd.

Mr. R. Harrison (of North Adams). I heard you mention contagious abortion. Are you troubled with it considerably? Can a cow overcome this so you can keep her in your herd?

Mr. Ellis. We have very few cases of a cow aborting the second year. Were I situated like the ordinary farmer, supplying milk to the contractor, so the loss of the product would not inconvenience me, and considering effect on my own herd alone, I would sooner have the foot and mouth disease come into my herd than contagious abortion. It would cost me less money, in the long run. I do not want to belittle the foot and mouth disease, but I do want to emphasize the difficulty with contagious abortion. I had it seven or eight years ago, and it is most serious.

Mr. Harrison. You have abortion occasionally. What do you lay it to, generally speaking, — to the cow being roughly handled, or what?

Mr. Ellis. If only occasional, it is generally the result of accident.

Mr. Harrison. How is it with younger cows and older ones, as compared to the number of cases?

Mr. Ellis. It is about the same proportion.

Mr. Harrison. What has been your experience with

reference to abortion? I want to know in regard to a cow carrying her calf after she has aborted once, — does she twice? My experience is that, when I have had one abort even several times, after she drops a live calf then there is no more abortion. After they drop a live calf, I had rather have them than one that never aborted.

Mr. Ellis. We have very few cases of abortion the second time.

Mr. Harrison. Hasn't it been proved it is a disease, and not a mechanical trouble?

Mr. Ellis. Yes; but we use the greatest care in disinfecting both our bulls and cows.

Mr. Harrison. I would like to know what you use for antiseptics, and how soon you allow service after abortion.

Mr. Ellis. The time would vary, — never less than three months, and from that up to six months, depending upon the condition of the cow. Carbolic acid is as good as anything. It makes very little difference which of several antiseptics you use, as long as they are properly used.

With reference to pasturing, I will give the experience we had last year in one pasture. We leased a pasture of about 132 acres. In one corner there were several acres of pine woods, in another corner quite a lot of marshy land, so there was very little over 100 acres left to pasture. We put into the pasture 65 heifers and a bull, and it not only carried all those animals, but we found the grass was getting ahead of us. We mowed two tons of good hay in July, and put 30 dry cows there about six weeks in one part of the pasture, and those taken out the day before Thanksgiving were fat.

Dr. J. B. Lindsey. I believe this is a subject of very great interest to the farmers of Massachusetts. I have felt for a long time, and still feel, that we as dairymen did not give sufficient attention to the improvement of our dairy stock. It has been a great pleasure to me to visit occasionally Mr. Ellis's herds, and see what a wonderful improvement he has made and the great success he has had in developing his herds. He has 200, more or less, of as fine heifers — the finest, I might say, that I have ever seen,

and he has done that by applying common-sense in their development. I wish every one of you could see that herd of young stock. I don't mean to say we all could have just the breed he has, — that breed is suited to his particular condition; but I do believe that we can make a herd develop suited to our conditions, and I think the hit-or-miss plan which so many farmers in Massachusetts are following at the present time is a great mistake. I think we should take pride enough to endeavor to build up our herds and improve them. I do hope that the members of this Board will take sufficient interest to go home and preach improvement in dairy herds among the people with whom they come in contact.

Mr. Van Norman. I would like to supplement somewhat that which Mr. Ellis has said, and to answer a little more fully Professor Cooley's question, as to how the farmers of Massachusetts can improve their herds.

What Mr. Ellis has said is based upon accurate records, kept as he wants them kept, and in such a way as to give him the knowledge on which to conduct his business. If there is any one thing that I am sure he would wish to emphasize in reference to this, it is that you should have accurate knowledge of each individual cow, know what she is doing, and have the sand to cut out those who are not doing the business.

I would say, then, the first thing in improving your herd is to know your herd, and know what each one is doing. And I would say that we have no rules, only maxims. We endeavor to see that there shall be an intelligent observation of every individual, and that that individual shall be treated as her conditions require. For that reason I did not wish to answer the question definitely as to how much feed we give our heifers. It does not make much difference, as Mr. Ellis says, if they get there in their work. We try to develop a heifer so that she will give a maximum amount of milk, 6,000 or 7,000 pounds, by careful observation of her condition and constitution, giving her grain up to the limit where the result is best, but we won't exceed 12 pounds per cow per day. What difference does it make what you feed

that heifer, if you develop an 8,000-pound cow? I would emphasize that side of this subject, — that you know your cows, know them individually, know how much they can make use of, and know what that will do.

QUESTION. What grain do you feed?

MR. ELLIS. As I said before, our mixture at present is 1,150 pounds of bran, 450 pounds of middlings, 850 pounds of corn meal and 400 pounds of cotton-seed meal. We vary that somewhat, as the cost of feed varies. This year we are feeding corn meal where ordinarily we should not because of poor quality of ensilage.

QUESTION. Do you feed gluten meal, — it is cheap enough.

MR. ELLIS. We do at times.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock by First Vice-President Sessions, who called on Professor Brooks of the Massachusetts Agricultural College to explain the exhibit of corn in the hall, made in connection with the meeting of the Board. In response to the call, Professor Brooks spoke as follows: —

Experiments with Corn, based on Exhibit of Crop of 1902.

I presume you have all had opportunity to examine the exhibit of corn grown during the past year in the experiment of which I am going to speak. The exhibit includes the entire product of each plot in the field. The area of the plots is one-twentieth of an acre each. The printed slips which have been circulated, and of which I think each of you has one, give much of the information which is needed for an understanding of the significance of the varying yield on the different plots. The kind and quantity of manure or fertilizer applied to the several plots is shown by the labels accompanying the exhibit. The printed slip, which is given below, also gives this information as well as a statement of the yields of each plot.

Corn Exhibit, North Adams. — South Soil Test Acre.

Experiments were begun on this field in 1889. Previous to this year the land had been in grass for several years without manure. The soil is a medium loam, underlaid by gravel. At the start, the plots, without manure or fertilizer, in a good season produced about 25 to 28 bushels of corn per acre; now the similar product is 6 to 10 bushels. Each plot has yearly received an application of the same fertilizers, and usually in the amounts shown below. The exceptions to be noted are: —

1. In 1897 double the usual amounts of all fertilizers was applied, as an effort was made to grow a crop of onions, — a failure, on account of poor germination.

2. The whole field was limed at the rate of 1 ton per acre in 1899.

3. Lime and plaster have been used at the rate of 400 pounds per acre since 1899 respectively on plots 5 and 13.

Fertilizers used, and Yields.

Plots.	Fertilizers used.	Fertilizers per Acre (Pounds).	Yields, 1902. Grain (Bushels per Acre).	Yields, 1902. Stover (Pounds per Acre).
Plot 1,	Nitrate of soda,	160	7.3	1,180
Plot 2,	Dissolved bone-black,	320	11.4	1,780
Plot 3,	Nothing,	–	10.4	1,480
Plot 4,	Muriate of potash,	160	47.7	4,760
Plot 5,	Lime,	160	4.9	860
Plot 6,	Nothing,	–	10.4	800
Plot 7,	Manure,	5 cords	68.7	6,220
Plot 8,	Nitrate of soda,	160	–	–
	Dissolved bone-black,	320	11.2	1,380
Plot 9,	Nothing,	–	9.2	1,360
Plot 10,	Nitrate of soda,	160	–	–
	Muriate of potash,	160	53.4	3,540
Plot 11,	Dissolved bone-black,	320	–	–
	Muriate of potash,	160	55.9	4,640
Plot 12,	Nothing,	–	8.8	1,300
Plot 13,	Plaster,	160	14.6	1,880
Plot 14,	Nitrate of soda,	160	–	–
	Dissolved bone-black,	320	–	–
	Muriate of potash,	160	56.2	4,540

The object of this experiment has been to throw light upon the special needs of different crops, and the results show conclusively that they differ greatly.

The crops grown in the several years beginning with 1889 are;

corn, corn, oats, hay, hay, corn, rye, soy beans, white mustard (plowed in), corn, corn, hay, hay, and corn. The crops especially benefited by potash are corn, clover and soy beans; those especially benefited by the nitrate are oats and grass; one has been especially benefited by the bone-black, — mustard. Other experiments indicate that cabbages, turnips and rape resemble the mustard in their needs.

The soil where this corn was grown is a medium loam, not over rich. It, however, has good natural characteristics. It holds water sufficiently, and not too much. It is not likely to suffer from excessive wetness; on the other hand, it does not suffer very badly from quite a severe drought. It is naturally pretty good land, so far as texture is concerned. It was in pretty fair condition when we commenced with the fertilizer. At the time we began, we raised without manure or fertilizer about 25 bushels of shelled corn to the acre. We planned the experiment not to see how big crops we could grow, but solely with reference to throwing some light on the general question of what different crops need on that soil, — what elements they would need to make them grow, — and it was solely with reference to that point that we selected the materials we would use. I do not believe that nitrate of soda is necessarily the best thing to use for nitrogen, nor that dissolved bone-black is necessarily the form of phosphate which you always ought to buy, nor that muriate of potash is always the best potash. We took these three because they give good results, and because they can always be depended upon and are always quite uniform. Nitrate of soda can always be depended upon to contain about the same percentage of nitrogen, the bone-black always contains just so much phosphoric acid, and the muriate of potash runs pretty even in the percentage of potash it contains. What we tried to do was to see the influence of the nitrate of soda, of the bone-black and of the muriate of potash on the different crops we grew on that field. We grew corn in 1889 and again in 1890; then we had oats, and sowed grass and clover with the oats. We cut four crops — two each year — in 1892 and 1893. In 1894 we grew corn; in

1895, rye; in 1896, beans; in 1897 we tried to grow onions, but finally grew white mustard, which was plowed in, — that being the only crop that has been plowed in during this time. The next year, 1898, we grew corn; in 1899, corn again. In the spring of 1900 the land was seeded to mixed grass and clover, and was cut once that year; in 1901 two crops were cut: and this year the land, having been plowed last fall, was put into corn again; so we have had in all six corn crops during the fourteen years.

Now, the results for the corn crops are, as you can plainly see by the exhibit, very striking. The land on the plots marked "nothing" had no fertilizer in fourteen years; that land is so poor that it bears somewhere about 8 or 10 bushels of corn to the acre. I would call your attention to the fact that undoubtedly even that is an overestimate of the corn; but I have adopted one uniform rule in figuring for all the plots, — I weighed the corn three weeks after it was husked, and allowed 90 pounds to the bushel. I don't suppose that the corn crops on these four "nothing" crops, when we weigh it after shelling, will amount to more than 2 or 3 bushels to the acre. The use of muriate of potash alone, through fourteen years, gives us a crop this year — a poor corn year — of almost 50 bushels; I call that nothing less than remarkable. I would not have believed that any such result would follow. If you will observe the exhibit, you will see that on those plots where potash has been used there is a good crop of corn, and no crop on those where it has not been used, — excepting, of course, the manure plot.

The influence of nitrate of soda and dissolved bone-black seems to have been very small indeed. The one fertilizer which has paid for itself over and over again on that land, for corn particularly, is the potash. Now, don't go away thinking that I believe that potash is the only fertilizer element we need to make our fields productive. I find with most of our land it is not right to consider the bald question, What does the land need? The land does not need anything, but it is what you need to put on your land to raise the crop; and it is not the same for all crops, and

to show that, I will call your attention to this chart. If I suppose that the increase that is due to using nitrate of soda is represented by the number 100 for all crops we have grown, the influence of the bone-black where used alone is 55, and the influence of the potash is 412 for corn; but with the oat crop, if we call the increase 100 where nitrate of soda is used, the increase due to the bone-black is nothing, and that due to the potash is 35. You see, then, it is not a question of what the land needs, but what the crop on the land needs. You may say, This land is now in different condition from what it was when we grew oats. No, I think not; I think the result would be the same if I should put oats on the land now, — the nitrate of soda would be what would pay. But when you come to the rowen, if we call the increase of the nitrate of soda 100, that of the potash is 340, — almost three and one-half times as much. This is because the potash is favorable to the growth of clover. I want to call your attention, your very special attention, to the fact that, if you will so treat your land as to make clover grow well, do well, then it becomes possible to raise corn very cheaply indeed. That is specially illustrated by that division of the exhibit which shows the product where dissolved bone-black and potash have been used continuously. The actual cost of the fertilizer is very low; you will be interested to know how low. Where nitrate of soda is used, it costs $3.60 an acre; bone-black alone, $2.88; potash alone, $3.25. On this particular plot I have been speaking of, where bone-black and potash alone were used, the annual cost of fertilizer was about $6.25 an acre. That is not very much to put out for fertilizer. It is true that that combination gave a good corn crop at the beginning; it gives a splendid corn crop now; and the plot does not seem to be growing poorer, but improving, if anything. It now gives splendid crops of hay, as well as fine corn crops. I want to impress you, if possible, with the fact that you as farmers should use your utmost endeavor to bring your soil into such condition that it will bear good clover, — not necessarily clover alone, but clover with mixed grasses.

The crop with manure, you see, is best of all. Manure is all right, — I have nothing to say against it; but we don't have manure enough to go around. We want to find out what fertilizer we can use to supplement the manure. And in answer to the question, What shall be used? I would say, use some potash with the manure. You can raise corn with manure alone, but it is not the best way. I have a field where I have used a light dressing of manure for thirteen years with a little potash. If I estimate the manure as worth $5 a cord on the land, the difference in favor of the light dressing of manure with potash as compared with a heavy dressing of manure alone means the saving of about $7.50 a year, and the crops of corn are almost equal. I will admit the hay crop is heavier on the heavy dressing of manure than on the small amount of manure and potash. But I believe in a few years I am going to get that land where the small amount of manure and potash are used so that it will be equal in productiveness to the other. It is gaining on it from year to year, almost solely on account of the influence of the clover, which always does better there than where the manure alone is used.

How far can you farmers safely follow the hints which I hope I have made clear? I am by no means sure you always will get similar results on your soils. I have made similar experiments in different parts of the State, one or more in every county in the State; and with one or two exceptions the potash has usually increased the corn crop more than either of the other fertilizers that have been used. So I should say you are quite safe if you use manure, as I suppose you do, to use it moderately with a moderate amount of some potash salt. I believe then you will raise corn more cheaply than you are now doing. All the potash we have used has always been spread broadcast after plowing the ground, and then it has been harrowed in.

I at first used muriate of potash, now we use sulphate. I planned this experiment before as much was known of these two salts as now. If I was beginning over to-day, I should use sulphate instead of muriate. The continued use of muriate of potash and nitrate of soda had the effect

of bringing the soil into a clammy condition, and the potash no longer gave the increase in the corn crop that we had been getting. We had been getting 40 to 50 bushels to the acre, where we used potash and nothing else. The year before lime was put on, the yield was 18 bushels to the acre, and the yield where we used nitrate of soda and potash was even worse than where potash alone was used. I suspected the cause, which is deficiency of lime. The continued use of muriate of potash causes a loss of lime in the water which soaks into the soil; and if you use muriate of potash it will in most cases be necessary, once in I think from five to seven years, to give the land a heavy application of lime. If you use sulphate of potash, the necessity of putting on lime will be less. I don't know yet whether it will be entirely unnecessary; I think an occasional application may be necessary.

The CHAIR. Mr. W. C. Jewett has been asked to preside at this afternoon session.

Mr. JEWETT. I think we all realize that the tillers of the soil have no greater friend than the United States Department of Agriculture. I think we have all been surprised, but pleased, to see the great advance it has made in all lines of agriculture. We members of the grange realize now what we have been striving for for so many years; and one writing up the history of agriculture should give our national grange the credit of having first conceived the idea resulting in the present Department of Agriculture.

I have great pleasure in introducing to you the assistant secretary of the United States Department of Agriculture, Hon. J. H. Brigham, who will tell us about its work.

WORK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE.

BY HON. J. H. BRIGHAM, ASSISTANT SECRETARY.

Although of comparatively recent establishment, the Department of Agriculture is regarded as one of the most important executive branches of the government. It comprises twenty-two bureaus and divisions.

Weather Bureau.

The Weather Bureau, the largest bureau of the department, extends its operations over every part of the United States and many of our dependencies. Its value to the farmer is well illustrated in the large amount of money annually saved by the warnings of cold waves. Immediately upon the development of a marked cold wave, the meteorological stations of the Bureau are directed to make observations every few hours in the regions immediately in advance of the cold wave, and to telegraph the same to headquarters. Warnings are then sent to all who have produce or perishable articles of manufacture that require protection from a low temperature. The Bureau has distributed as many as 100,000 telegrams and messages in the space of two hours, and nearly every city, village and hamlet has received information in time to profit thereby.

The importance of this information to the farmer is exemplified by the statements gathered by the Bureau from persons interested relative to the sweep of one cold wave, which showed that over $3,400,000 worth of property that would have been destroyed by the low temperature was saved.

The Weather Bureau has a complete system for the accu-

rate and rapid collection and dissemination of crop information.

Twelve hundred skillfully trained officials outside of Washington are employed to report on all matters concerning weather, crops, climate or statistics. The Bureau has 315 paid temperature and rainfall reporters, who make daily telegraphic reports from growing fields of certain cotton, corn and wheat centres. It has 3,000 voluntary observers, one for nearly every county in the United States, who serve the government by making daily observations and rendering weekly crop reports. Fourteen thousand persons report weekly to the climate and crop centres on the effect of the weather upon crops in their respective localities. This number could easily be increased to several hundred thousand, if necessary.

It is estimated from the reports furnished by truck farmers in the sugar cane and orange growing districts of Louisiana and Florida, respectively, who time their operations by the frost warnings of the Bureau, that the amount annually saved to them is far greater than the cost of the entire department.

Thousands of dollars worth of property have been saved by the flood warnings telegraphed all over the United States by the Weather Bureau.

In the great flood of 1897, warning bulletins preceded the flood by several days throughout the whole area submerged, and statisticians of the government have estimated that $15,000,000 worth of live stock and movable property was saved.

One of the most important additions to the work of the Bureau has been the distribution, through the instrumentality of the rural free mail delivery, of forecasts of frosts and cold waves to the very doors of those who can make the most profitable use of them. The latest forecasts of the weather are printed on small slips of paper, and each carrier is given a number equal to the number of houses on his rural route.

The last appropriation for the support of the Weather Bureau was $1,263,760, and it is the opinion of many insur-

ance and other experts that the Weather Bureau service is worth more than $20,000,000 annually to the agricultural and other industries of the United States.

Bureau of Animal Industry.

The Bureau of Animal Industry is of great importance not only to the farmers of the United States but to the large class of consumers. One of its most valuable functions is the inspection of meat. Two-thirds of the annual appropriation is expended in this service. In the past year the inspection of cattle, sheep, calves and hogs and their products was conducted at 154 abattoirs and packing houses in 49 cities. There was an increase of 2,789,338 in the total number of inspections made. The value of this work is illustrated by the reduction in insurance rates on exported cattle from 8 per cent to less than one-half of 1 per cent. The Bureau has made compulsory the sanitary equipment of all ships carrying cattle abroad, which has reduced to a minimum the danger of sickness and death en route. More than two and a half millions is saved annually by this reduction of insurance rates, which is twice the amount annually appropriated for the maintenance of the Bureau.

The Bureau is continuing its inspection of all southern cattle, with a view to controlling Texas fever.

The officials have inspected 11,186,661 sheep, in order to prevent the shipment of sheep afflicted with scabies or that have been exposed to that disease, and 1,017,162 were dipped under the supervision of the Bureau inspectors.

Large quantities of tuberculin have been shipped throughout the country, and a large amount of mallein sent to the War Department and State officials. About 55,000 doses of tuberculin were sent in the last year to 33 different States, and 12,000 doses of mallein to 25 different States.

An elaborate experiment was conducted in the laboratory of the Bureau for the purpose of establishing the presence or absence of tubercle bacilli in the milk of tuberculous cows, in order to demonstrate the infectiousness of milk in tuberculous cows. This experiment lasted ninety days, and

included the milk of 56 tuberculous cows. A synopsis of the results shows that one or more of the guinea pigs fed on the milk from each cow succumbed to tuberculosis. Owing to the greater percentage of positive results obtained, it appears probable that the virulence of the milk increased with the advancement of the disease in the cow. The combined results of the experiments show that the milk of 12 out of 56 cows, or 21.4 per cent, has at one time or another since the beginning of the experiment contained tubercle bacilli.

The demand for blackleg vaccine, manufactured by the Bureau, is gradually increasing as this method of preventive treatment becomes better known and its merits more widely heralded. In the last year 1,688,885 doses of vaccine were distributed throughout the United States, and 565,628 cattle were vaccinated, of which number 2,902 died after vaccination, a little more than one-half of 1 per cent. If we eliminate the number of animals that were probably infected before they were vaccinated, and which died after the injection, also the number of deaths which were acknowledged by the stock owners to be the result of their own mistakes, the number of cows that died after vaccination is reduced to 2,538, or .44 per cent.

An important branch of the Bureau of Animal Industry is the dairy division. A general survey of the conditions of the dairy industry of the country was begun when the division was organized, and special inquiries have been made, looking to the development of foreign markets for the dairy products of this country.

Special agents have been sent to Japan, China and the Philippines, for the purpose of investigating the market conditions and arranging for a series of experimental exports of dairy products from this country. Other agents have been sent to Canada, Belgium and Holland. Exports of dairy products have been made to Japan, Cuba and Porto Rico. This method of making known the better grade of these products has resulted in increased sales by merchants in San Francisco and New York.

Inquiries by correspondence indicate that there are good

opportunities for finding markets for dairy products in Mexico and South America.

In the last year, in accordance with an act of Congress, the division has inaugurated a system for the inspection of dairy products offered for export, affixing stamps to the same, and certifying to the character and quality of the articles; the object of which, according to the language of the law, is "to ascertain the purity and quality of such products and secure their identity, and make known in the markets of foreign countries, to which they may be sent from the United States, their purity, quality and grade." Special agents were appointed and placed on duty as inspectors of dairy exports at the ports of Boston, New York, San Francisco and Chicago.

Bureau of Soils.

Interest in the Bureau of Soils is growing rapidly, and the demands for work in different parts of the country are increasing, as is shown by the liberality of Congress in enlarging the appropriation, and by the many requests received for the extension of the different lines of investigation. The Bureau of Soils now has a force of over 100 persons, 75 of whom have a scientific training. It is believed that the results of the work, in showing the condition and resources of the soils of the country, and in giving the people precise and accurate knowledge as to the possibilities of the soils, justify fully every expenditure that has been made.

With the fierce competition for commercial supremacy now going on, every particle of information bearing upon the natural resources of the country which will in any way tend to increase the present crops or develop new methods and build up new industries is of the utmost value, especially if the people are inspired with sufficient confidence to heed the advice of the department and to take advantage of its work.

In the last year the Bureau of Soils has surveyed and mapped 14,541 square miles, or 9,306,240 acres, which, added to our previous survey, makes a total of 22,623 square miles, or 14,478,020 acres. This work is carried on

in 25 States and Territories, and in Porto Rico. The cost of the work per square mile varies from 71 cents in the Covington area, Georgia, to $5.02 in Porto Rico. The average cost has been $1.83 per square mile.

Some time ago the officials of the Bureau began an experiment with Sumatra tobacco in the Connecticut valley, and it has been demonstrated that this tobacco can be grown successfully in that locality. The ordinary tobacco grown in the open fields in Connecticut brings, on an average, from 18 to 20 cents a pound, while the average price paid for the Sumatra tobacco is $1.20 per pound. It is believed that the Sumatra tobacco can be grown in other localities than the Connecticut valley.

Bureau of Forestry.

The importance of the work of the Bureau of Forestry is being recognized more and more as its work becomes better known. Applications for assistance in introducing practical forestry were received for 4,709,120 acres in the last year. The Bureau, for lack of men and money, was obliged to defer over 90 per cent of these applications, and aid was given in the case of only 373,463 acres. Forests in the United States are very largely owned by private persons, and this inability to respond to more than 8 per cent of the requests for advice forms the most serious check on the progress of forestry.

Public forest reserves on Sept. 1, 1902, aggregated 58,-850,925 acres: and in the past year the Bureau has prepared for the Secretary of the Interior working plans for conservative lumbering on these reservations. Field work was done in 5 public forest reserves, and trained foresters supplied for all the national reserve. At the request of the Secretary of War, working plans were made for 8 military wood and timber reservations, including the military reservation at West Point, covering an area of 117,468 acres. Computations for 16,678 acres were completed, and measurements of the rate of growth of 10,786 trees of 25 species in 13 States were made.

Bureau of Plant Industry.

The Bureau of Plant Industry has been experimenting in the southern States in an effort to discover a species of cotton that will prove to be resistant to a parasite that has destroyed many strains of the finest cotton, and the Bureau officials have discovered that the parasite can be overcome. It has also introduced a strain of cotton of better yielding power and longer and better fibre, which will add greatly to the yield of the cotton crop.

The importance of leguminous crops for increasing the nitrogen contents of the soil is becoming more and more apparent to the American farmer. The department has discovered an entirely new method of growing and distributing nitrifying organisms, and also increasing their nitrogen-affixing power. It is expected that the department will be able to distribute these organisms within a short time.

One of the most important problems that has engaged the attention of the Bureau has been the securing of crops for the semi-arid regions of the west and the desert region of the south-west, and gratifying success has been met with. We have successfully imported the finest varieties of the date palm, and Egyptian cotton, also adapted to the arid areas, has been successfully introduced. The introduction of this crop will mean a great deal to the cotton industry.

Until recently nearly all the macaroni made in the United States has been manufactured from the American bread wheats. The macaroni has been of an inferior quality, and in consequence large quantities of the European-made macaroni have been imported.

There is a great demand for macaroni wheat, not only in this country but in Europe. This wheat grows with ten inches of rainfall and is adapted to a belt of territory extending through western Texas, Oklahoma, Kansas and the Dakotas. Tests made by the department have proved very successful, and the quality of wheat produced is equal if not superior to some of the varieties grown in Europe. Extensive mills are in process of erection for the handling of this wheat, and changes are being made in present mills for the

grinding of it. Two million bushels will be produced this year. The department predicts that this wheat will ultimately add $20,000,000 to the annual profits of wheat-growing in this country, and furnish a sure crop for a large agricultural region subject to drought.

New methods of harvesting and handling blue-grass seed have been discovered, which will increase the value of the blue-grass crop from 30 to 40 per cent. A new method has also been demonstrated for securing pasturage of Bermuda grass, which will prove a partial solution of the forage crop problem in the south.

The Bureau has also turned its attention to the solution of range improvement in the west. Many of the finest ranges there have deteriorated, the causes for which have been stated by the department. Extensive experiments are now under way, showing how the ranges can be improved and reclaimed.

The Bureau is endeavoring to open up foreign fruit markets. America can grow the finest fruit in the world, and, if it can be placed upon foreign markets in good condition, there is an almost unlimited sale for it. In the past year the department has been successful in placing peaches, pears and other perishable fruits in European markets, with a good profit to the producers.

Another important industry that is being stimulated by the department is tea growing. A new tea farm of 100 acres with a fully equipped factory has been developed. One thousand acres of tea have been started on the rice lands of Charleston, and the tea produced on this farm is pronounced by experts to be equal to the best imported tea. The cost of production is 15 cents per pound, and the yield 5,400 pounds per acre. The wholesale price is from 40 to 50 cents per pound, and the retail price from 75 cents to $1.

The Bureau has been extending its work in the south along the Gulf of Mexico, in an effort to improve the rice culture. New varieties have been secured, and over $20,000,000 have been invested in the rice industry in the region mentioned. The United States will now produce

all the rice used, and soon will be exporting considerable quantities.

In the congressional seed distribution the department is endeavoring to fulfill the original intent of the law, — to distribute rare and valuable seeds. Many of these are being obtained through seed and plant introduction and by the scientific investigation of the various branches of the Bureau in the production of new crops by breeding.

Division of Statistics.

This office is chiefly engaged in ascertaining the area, production and value of the principal farm crops annually, and the condition of these crops monthly while they are growing. Dependence is placed, primarily, upon three sets of correspondents, with important additional sources of information in the case of cotton. Of the 2,800 counties in the United States, about 2,500 are represented by county correspondents, each of whom has three assistants reporting directly to himself, upon a plan similar to the one governing his own report to the department.

The township is the unit for which correspondents of another corps report, their number being about 30,000, representing most of the agricultural townships of the country.

These two corps of correspondents report directly to the Washington office, but there is a third corps of correspondents reporting in each State directly to a State agent, upon a plan similar to that governing the other corps, and these reports are tabulated by the State agent, and the results sent by telegraph or mail to Washington.

Each corps of correspondents is kept entirely separate and distinct, no one individual being allowed to serve upon any two of the lists, and the returns made by each corps are tabulated independently.

The three reports are brought together in convenient form on the 8th of each month: and the statistician is thus provided with three separate statements, covering the same territory and the same crops, made by separate corps of correspondents, each reporting in a territory with which he is thoroughly familiar, and from these results the statistician

compiles his own estimates. This information, however, is supplemented by the reports of special field agents, who traverse the producing portions of the country, procuring all possible data and carefully analyzing the same.

Information with regard to final yield per acre is further obtained from reports received from a very large corps of farmers, each reporting for his own farm.

With regard to cotton, supplemental information is furnished on special schedules by a corps of special cotton correspondents, embracing a complete corps of cotton ginners and a further corps of cotton planters, each reporting for his own plantation. This method is, however, employed only for the purpose of making a preliminary statement, the final figures being derived from statistics of movement and consumption obtained from transportation companies, port officers and mills.

In all tabulations careful attention is paid to the weight of the figures submitted, so that each county and each State may have its correct and proper influence in the determination of the total for the State or for the United States. The statistics are compiled with the latest census figures as a basis, the acreage and production being carried on from year to year by the percentage method, 100 representing the understood area of production of the preceding year.

The reports on condition of crops in their growing and maturing period, also, are based on the percentage system, 100 representing "a condition of perfect healthfulness, unimpaired by drought, hail, insects or other injurious agency, and with such growth and development as may reasonably be looked for under these favorable conditions." Reports of yield per acre and price per unit of quantity are of course reported quantitatively.

The total number of all classes of correspondents in the crop-reporting service aggregates nearly 250,000.

Reports regarding farm animals are made several times during the year, mostly concerning the number and value of the principal classes of these animals, but partly to ascertain their condition of healthfulness after passing through the winter.

Statements relating to live stock and to principal farm crops (except cotton) are made public on the 10th of each month, the cotton statements being issued on the 3d during the growing season; and, to make this information available simultaneously throughout the entire United States, the statements are sent by telegraph. Also, in order that the figures may be placed within easy reach of farmers at the earliest possible moment, cards containing the principal features of the report are mailed to every postmaster within from four to twenty hours of the time that the statements are telegraphed, and are conspicuously posted for the information of the public.

The Division of Statistics carries on a large correspondence with persons, not only in this country, but in countries in all parts of the world, in supplying information upon request, and from time to time makes special statistical reports upon subjects with which farmers are especially concerned.

The Biological Survey.

The Biological Survey is engaged in several lines of work of interest to the thoughtful farmer. For more than seventeen years it has been carrying on without interruption a comprehensive investigation of the food and food-habits of birds known or believed to be factors worth taking into account by the farmer and fruit grower. During this period it has studied the food-habits of a great variety of birds in the field, and has examined in the laboratory the stomachs of 22,000 birds. These investigations have led to some very important conclusions, many of which have already been published, and may be found in our bulletins on "Hawks and owls from the stand-point of the farmer," "The crow in relation to agriculture," "The English sparrow in America," "Four common birds of the farm and garden," "Birds that injure grain," "Food of woodpeckers," "Food of nestling birds," "Cuckoos and shrikes," "Bobolinks, grackles and blackbirds," "Food of native sparrows," and "Common birds in relation to agriculture." These bulletins tell the farmer and fruit grower what birds injure particular crops, what birds are beneficial in whole or

in part, and under each kind of bird give a concise summary of its food-habits at different times of year; so that, in the case of species which are injurious at one season and beneficial in another, the relative values of the harmful and beneficial qualities are pointed out. In some instances the injurious habits of a bird are confined to a particular crop or a particular season, and may be in large part prevented; while the habits of the bird during the remainder of the year are of so much benefit to the farmer that the species should be encouraged rather than destroyed.

A recent publication of interest to all farmers in the eastern United States is a bulletin entitled "The birds of a Maryland farm."

Some of the general conclusions resulting from these investigations are: —

1. That birds in general devour an enormous number of insects.

2. That the greater part of these insects are injurious to the farmers' crops.

3. That most of the insects that cause serious harm, such as grasshoppers, cut worms and tree caterpillars, are freely eaten by many kinds of birds.

4. That certain other pests, as the Colorado potato beetle, the chinch bug and the striped squash beetle, while not universally eaten, are still preyed upon by many birds, and the number of these birds is increasing every year.

5. That birds are one of the great natural forces operating to check the inordinate increase of insects.

6. That when serious damage is done by birds, it is usually due to a superabundance of one species, or of a few closely allied species, gathered in a limited area.

7. That many birds, particularly the native sparrows, devour enormous quantities of seeds of weeds, thus saving the farmer much annoyance and labor.

8. That many birds whose habits in some localities are harmful in other localities are almost wholly beneficial.

9. That the harm done by certain birds may be to a great extent averted (as by tarring seed corn, to prevent its destruction by crows).

Another field covered by the Biological Survey relates to game protection and introduction. About two years ago Congress passed a bill known as the Lacey act, which gave the Department of Agriculture authority to regulate the importation of mammals and birds into the United States, and placed under its jurisdiction all matters relating to the federal protection and preservation of game. While this is of much interest to the sportsman, it is of even more serious moment to the farmer and fruit grower. Some of our best game birds, notably the quail and prairie chicken, are of inestimable value as pest destroyers, consuming prodigious numbers of grasshoppers and other harmful insects. The quail devours enormous numbers of chinch bugs, and is one of the few birds known to feed on the Colorado potato beetle. The wholesale destruction of these birds by sportsmen and others is a matter for serious concern. The Biological Survey is making a special effort to regulate the killing of game birds, and to publish trustworthy information respecting their distribution and food habits. It is also helping the farmer by keeping out the mongoose, one of the greatest scourges known among mammals, and preventing the introduction of certain species of birds which are likely to prove as great a pest as the English sparrow. Under authority of the Lacey act, it keeps a close watch on importations of birds and mammals into this country, and issues permits for the introduction of non-injurious species.

But the most important work on which the Biological Survey is engaged is of a very different character, and consists in an effort to actually map the boundaries of the different agricultural belts and areas of our country. It has been found that areas fitted by nature for certain associations of native animals and plants are adapted to the cultivation of particular varieties of crops and particular breeds of stock. This forms the basis of the work of the Biological Survey proper, for, when the courses of the natural life belts are determined, they will be found to coincide with the boundaries of the crop belts. This, it goes without saying, is of the utmost practical interest to the farmer, particularly in newly settled regions, as the maps of the

Biological Survey will tell him beforehand what crops he can and what he can not hope to cultivate with reasonable prospect of success, thus saving the hundreds of thousands of dollars now thrown away each year in attempting to force crops to grow in areas where they cannot possibly succeed. The Biological Survey has completed a preliminary survey of the United States and has published a colored map of the life and crop belts, accompanied by lists of the varieties of fruits and farm crops adapted to each. It is now engaged in a much more detailed survey, which, when completed, should prove of benefit to every farmer in the land.

Office of Road Inquiry.

The popularity of the work of the Office of Road Inquiry has steadily increased since the organization of the office several years ago. Its employees are principally engaged at the present time in building object-lesson roads in different sections of the country. In this they have the hearty co-operation of a number of local authorities in different States, and it is intended not only to contribute something by way of co-operation on the part of the general government, but also to secure co-operation on the part of as many of the different interests connected with the road question as possible. The local community having the road built is of course most largely interested. The railroad companies generally co-operate, because they are interested in having better roads to and from railroad stations; they therefore contribute by transporting free of charge, or at very low rates, machinery and such foreign materials as are needed in the construction of a road. Manufacturers of earth-handling and road-building machinery co-operate by furnishing all the needed machinery for the most economical construction of the road, and in many cases prison labor is used in preparing material for the road bed. Contribution made by the general government in this scheme is both actually and relatively small, and it is by means of this limited co-operation that it has been possible to produce a large number of object-lesson roads in different States. These have proven to be beneficial not only in showing the scientific side of

the question, but the economic side as well. In the last few years a number of railroad companies have lent their support by running good roads trains over their lines.

A few years ago the Office of Road Inquiry established a laboratory for the testing of road-building materials, and it has proved of much benefit. Congress has shown its interest in the work of the office by making liberal increases in the appropriations for the maintenance of the work from year to year.

Office of Experiment Stations.

The Office of Experiment Stations supervises the expenditure of the national funds given to the several States and Territories for the maintenance of agricultural experiment stations, and aids them in various ways in the development of their work.

There are now 60 of these stations in the United States, and they employ about 700 persons in the work of administration and investigation. In the past year they published 445 annual reports and bulletins, which were distributed to over half a million addresses on their regular mailing lists. The total income of the stations is over $1,200,000, of which $720,000 is given by the national government and about $500,000 is received from the State governments and other local sources.

This office also directly manages the experiment stations in Alaska, Porto Rico and Hawaii, which have now become firmly established, and are doing good work for the promotion of agriculture in these remote regions. It also has relations with the experiment stations and kindred institutions throughout the world, and obtains from them much information which is of use in promoting the agricultural interests of this country. It has recently issued a bulletin describing the organization and work of 720 stations now in operation in foreign countries, for there is now hardly a region in the world that does not maintain these useful institutions.

The Office of Experiment Stations issues a large number of publications based on the work of the experiment stations at home and abroad. The most important of these

are the "Experiment Station Record," which is a monthly review of the scientific investigations of stations and kindred institutions throughout the world; and "Experiment Station Work," which is a popular series setting forth the practical results of station work.

The Office of Experiment Stations is also doing much to promote agricultural education throughout the country. In the course of the past summer its director was dean of a successful graduate school of agriculture held in connection with the Ohio State University, where many of the leaders of agricultural education gathered for a month, to discuss the problem of agricultural science and instruction with an advanced body of students collected from all parts of the country. He is also chairman of the standing committee of the American Association of Agricultural Colleges and Experiment Stations on Methods of teaching Agriculture. This committee has done much to promote the more systematic and thorough teaching of agricultural subjects in the colleges. It has recently turned its attention to the formulation of courses in agriculture for the high schools, and made a report on this subject at the recent convention of colleges and stations at Atlanta. This report will soon be published, and it is hoped will do much to aid the movement already begun for the introduction of the teaching of agriculture into our public high schools. The office has also given attention to nature study and school gardens, and it has published reports on these subjects. It is now actively seeking to promote the interests of the farmers' institutes, which are the schools for our adult farmers. Over 2,000 of these institutes are now annually held in the United States, and last year they were attended by over 700,000 farmers. They are a very effective means for the broad dissemination of reliable and up-to-date agricultural information; and the Department of Agriculture may well aid the States and Territories in the more thorough organization of these institutes, so that they will reach the masses of our farmers who are not yet alive to their value and importance.

The Office of Experiment Stations is also in charge of special investigations on the food and nutrition of man.

These are carried on in co-operation with the colleges and stations in different parts of the country, and the results of these investigations are already incorporated in courses of cooking and domestic science in hundreds of schools. Taken as a whole, they constitute the most thorough and wide-reaching investigation on this subject that has been undertaken in any country, and have attracted wide attention both at home and abroad. The office has numerous publications on this subject, which are freely sent to applicants.

Another large division of the work of this office is comprised in its irrigation investigations. These include studies of the laws and institutions relating to irrigation; measurements of amounts of water applied to different crops and soils; studies of drainage systems, and of pumps and other machinery used in irrigation. Most of this work has been done in the east and south, where irrigation is profitably used in raising garden vegetables, small fruits, rice, etc. Some attention is also being given to studies of farm machinery, and it is hoped to extend this work in agricultural engineering so as to include investigations regarding farm buildings, water and sewage systems, etc.

Bureau of Chemistry.

Investigation of the adulteration of food products has been one of the most important studies of this Bureau in the last year. Special attention has been given to the adulteration of olive oils of domestic manufacture, which are compelled to compete with cheaper and adulterated oils. Important investigations have been conducted by the Bureau in connection with economic forest products, such as tannin, gums, rubbers and wood pulps.

The road-material laboratory, which was established in December, 1900, tests road materials of all descriptions, free of charge; and those interested have only to send samples of their materials to this laboratory to have the road-making qualities of the materials determined. Only practical road builders of much experience realize the large amount of money wasted through an improper selection of material.

There are generally several materials available in every locality, and the difficulty of selecting the most suitable is evident. The only proper way in which a selection can be made is by means of physical and chemical laboratory tests.

Important investigations looking to improving the quantity and quality of table syrups have been made in the sugar laboratory, and critical studies have been undertaken to determine the influences that tend to produce the maximum content of sugar in beets, melons and other sugar-producing plants.

Studies of various insecticides in common use in agriculture have been conducted, in order to determine whether the poisons employed in such insecticides are found in the food products derived from the plants thus treated.

The study of the character of waters used in irrigation, especially in the growing of rice, have been begun, in order to determine the quantity of injurious salts which these waters may contain, and the quantities thereof that may be safely used upon the fields.

New laboratories have been established to study the effects of preservatives and other added substances upon the health of the consumer, with the view of determining the character and amount of such substances which may be safely used in such foods without injury to public health.

A drug laboratory has been established, to study the character, standard and adulteration of drug products. The larger portion of the drugs in commerce are of agricultural and horticultural origin, and the necessity of securing purity and conformity to standards in articles of this kind is evident. Dangerous narcotics and poisonous substances should not be indiscriminately sold, and drugs intended for ordinary therapeutical purposes should conform to the standards laid down by competent authorities.

The Bureau of Chemistry is constantly increasing the services rendered to other departments of the government in many different ways: as, for instance, the study of the character of cancelling inks used by the Post-office Department, and the colors and inks used for printing bank notes, bonds and other government securities.

Division of Foreign Markets.

The organization of the Division of Foreign Markets was prompted by the need of wider foreign markets, resulting from the rapid development of domestic agriculture and the consequent increase of farm produce which must find a foreign market. In order to take advantage of the favorable conditions abroad, the Division of Foreign Markets instituted investigation into the needs of foreign countries, in order to gain a thorough knowledge of the peculiar requirements of foreign consumers, and accurate information as to the supplies furnished by competing nations.

The success or failure of a line of trade depends on the ability of the producer to supply the article suited in quality and taste to the purchaser. Not less important in many cases is the need of yielding to the local custom regarding the terms of payment. It is the constant endeavor of the division to ascertain and disseminate information that will prove of value to the exporters of agricultural products of the United States. In stating the conditions of demand and supply in foreign countries, official statistics are supplemented by further details obtained from reports of consular officers, trade journals and various other sources of information. In cases of special importance, where printed returns and correspondence prove inadequate, the office has sent special agents to obtain by personal investigation the information desired.

Division of Entomology.

Important work has been done and is being done by the Division of Entomology, — work of vital importance to the farmers of the United States. In the past year, through the personal researches of an employee of the division, the original home of the San José scale has been found to be North China, whence it came in the early '70's to California, probably on some ornamental Chinese stock. A native Asiatic ladybird enemy has been found in China, which there keeps the San José scale in check. This insect has been imported to America, and is now being distributed in the prin-

cipal deciduous orchard districts of this country, and promises good results.

Probably the most important work of the Division of Entomology in the past year has been the practical experimentation with the Mexican cotton boll weevil in Texas. Two large cotton plantations have been under the control of the department, to demonstrate that by proper methods the boll weevil can be controlled. The results have sustained the confidence of the entomologist in the possibility of controlling this pest, which promises to be perhaps the most important insect that has ever threatened our southern cotton interests.

A great deal of practical investigation has been made of insects injurious to shade trees; also stored products, such as grain in elevators and mills and all milling products; insects affecting ornamental plants and various fruit trees; insects, in their direct relation to the health of man, as the mosquito, house fly and other similar pests; experimental work with insecticides and other means of controlling noxious insects.

A special line of work begun by this division in July last is the work on insects injurious to forests and forest products, for which a section has been established in the Division of Entomology, to work in co-operation with the Bureau of Forestry. The work with forestry insects has been especially in the Black Hills forest reserves, where more than 600,000,000 feet board measure of pine timber have been destroyed by insect attack. It has been found possible to detail methods, the adoption of which will largely decrease future losses.

The Division of Entomology is also charged with the investigation of apiculture, and considerable work has been done in this field. It is also conducting silk-worm investigations, and already plans are under way for the experimental work necessary to demonstrate a possible future for this industry, especially in the south, where it is hoped that the poorer classes of the people, especially the colored class, may be induced to take up silk rearing, and thus add somewhat to their means of livelihood.

Exposition Work.

The department has been represented at all the expositions held in this country since it became a department. At these expositions it has been the purpose of the department to show to visitors what is being done for agriculture. In this way many persons who feel that they cannot visit Washington have an opportunity to see some of the department's work.

All proposed legislation pending in Congress that especially interests agriculturists is referred to the Secretary of Agriculture, and he is asked to give his views in regard to the proposed measures; and these views carry great weight with members of both branches of the national Congress.

The department is also consulted by executives who are charged with the enforcement of laws for the protection of agricultural interests, and has rendered valuable assistance along these lines.

The department takes a lively interest in the work of all associations formed for the promotion of agriculture, and is always glad to co-operate when it is possible to do so; in short, the department will help all farmers who try to help themselves.

Statesmen appreciate more than ever before the vital importance of guarding well this indispensable industry. They look to the home-loving, law-abiding farmer to hold in check organized capital and labor, whenever either seems inclined to encroach upon the rights or interfere in any way with the liberty and personal freedom of any citizen of the Republic. The sons of the farmers who "fired the shot heard round the world" will tolerate no improper interference with the liberty bought and preserved at such a fearful cost of human life and suffering.

The Chair. I wish to say a word in regard to the lady-bird. The question has been asked if there is any encouragement for any one to go into the raising of fruit, under the present conditions of the San José scale. I met recently representatives of the States of California, Washington and Oregon. They said now they have nothing to fear from the

San José scale. Where the ladybird is now generally introduced, it is holding the scale in check, and they think in a short time the scale will be controlled by this insect.

QUESTION. I would like to inquire how our institution of the free distribution of seeds is looked upon by the Department of Agriculture?

Mr. BRIGHAM. That is a question we don't enter into. We are there to obey the law, and we distribute them. Any time any one makes warfare, Congress immediately doubles the appropriation. A great deal of valuable seed has been distributed; a great deal, though, is common seed.

The CHAIR. Is there not a great demand in certain parts of the country for this seed?

Mr. BRIGHAM. Three to five clerks are opening letters in regard to seeds, — requests for seed.

The CHAIR. When people talk against this seed distribution, they little realize the condition of farmers in other parts of the country, and if they did, they would have a little more sympathy with the distribution of seeds by our national government.

Mr. BRIGHAM. The department is working towards the rare and new kinds of seeds and shrubs all the time.

Secretary STOCKWELL. I would like to inquire how the State of Massachusetts stands with reference to pure food laws, with regard to other States. Is there anything more that can be done than Massachusetts is doing in regard to pure food laws?

Mr. BRIGHAM. Massachusetts is far ahead of many other States. In some States the farmers even do not appreciate the importance of dealing with these laws. There is some opposition, but not very much. The cotton grower down south thinks if you won't let him make oleomargarine you will ruin him. We expect Massachusetts to lead. That is a good deal for a Buckeye to say. I am glad to note the fact that you are at the front in this line. We are going to help you all we can; you must do your part also.

Secretary STOCKWELL. There is another point which reflects upon the credit of the department at Washington, and that is, in connection with the work we have been

doing against the gypsy moth. We in Massachusetts felt sure that, having begun a good work, we should carry it out to the end. When we got to the point where the Legislature could not see actual results of it and were not inconvenienced by the caterpillars, the appropriation was stopped. We had got to where there was not an extensive colony extant, and now the work has to be done over again. I would like to ask if there is any hope that the national government will take hold of this pest. It is a peril to the country.

Mr. Brigham. That is a question I do not feel justified in answering. Congress is much like the State Legislature. With anything like the foot and mouth disease, why, then we can appeal to Congress with considerable hope of help. Our department works under law, and with our appropriations we can help investigate and study and ascertain, but we could not do the work of suppression or extermination. I would not hold out much hope on that line. You know the gypsy moth does not spread very rapidly, so these other people in Texas or California are not afraid of it yet. Just like a man dieting for health, — when he begins to feel better he wants to go to eating again; that is the way with these Legislatures.

Mr. ——. I would suggest that, if the department does not feel like helping us because the female of the gypsy moth does not fly, we have also the brown-tail moth, and the female of that insect does fly.

Mr. Lyman. I was very much pleased to hear Mr. Brigham speak of our helping the department. We can help the department very much by answering their questions when they send us blanks. I think Mr. Brigham emphasized that point.

Mr. Brigham. It is very important.

In the evening, from 8 to 10 o'clock, a reception was tendered by the Board of Trade and citizens of North Adams to the Board of Agriculture and others attending the meeting. The reception was held at the "Wellington," and was a very delightful occasion.

THIRD DAY.

The meeting was called to order at 9.30 o'clock by First Vice-President Sessions, who asked if there was any business in order.

Mr. John G. Avery (of Spencer). I move a vote of thanks to the citizens of North Adams and to the local society for their royal entertainment last evening, and also to the various speakers who have been with us and have given us such admirable papers that have been so instructive. I have no doubt we will all be benefited by our visit to North Adams.

The motion was seconded and unanimously passed by the Board.

Mr. A. A. Smith (of Colrain). This morning the secretary of the Board and myself made a visit to Mr. Carpenter, delegate from the local society, and we found him much better than we expected. He was able to be up, and treated us with that cordiality that is so characteristic of the man, and he wished to be remembered to all the members of the Board.

The Chair. The next in order is the lecture by an eminent gentleman from Boston, whom we have heard before and appreciated, and from whom we expect to receive instruction and entertainment at this time. M. F. Dickinson, Esq., of Boston, will speak upon "Rights and duties concerning highways."

RIGHTS AND DUTIES CONCERNING HIGHWAYS.

BY M. F. DICKINSON, ESQ., BOSTON.

When I had the honor of addressing this Board two years ago, at its December meeting in Worcester, I hardly expected so soon to be called upon again to perform a similar service. My topic at that time was "Some aspects of the law as applied to rural affairs." The discussion which followed disclosed a deep interest in reference to the subjects discussed, so that when I accepted the invitation for this year I thought something along the same line would not be unacceptable. My first paper, however, covered so much ground that I find myself somewhat in the condition of the young minister, who, after preaching his first sermon, inquired of an old veteran of the pulpit what he thought of it. "The sermon was good," said the old man, "it was good; you covered the whole range of religion and theology, but I don't see how you can ever preach another."

My subject to-day is "The highway,"— a historical glance, a few facts concerning it, and some rights and duties thereto appertaining.

An unerring indication of the relative positions of States in the scale of advanced civilization is found in the condition of their roads. Of course in a country newly settled we do not look for that perfection in construction or excellence in maintenance that prevails among old and settled communities; nor in the rapidly multiplying streets of a thriving young city the thoroughness that distinguishes older and wealthier municipalities; nor as yet in the remote roads and byways of our rural counties for work according to the gospels of Macadam or Telford. Still, the general proposition will have to go unchallenged that good roads are unequivocal signs of prosperity, growth, enlightenment and civilization.

Roman Roads.

One ancient race was pre-eminently distinguished as a great road builder, — the Roman. The Appian Way, leading across the Pontine marshes and thence southward through the Italian peninsula, was the famous highway of the old world. It still remains one of the most venerable and interesting monuments of the classic age. It was begun three centuries before the Christian era; and in the golden days of the empire was adorned with splendid mausoleums, statues and monuments. Its name was as familiar, not only in Italy, but also in the distant provinces, as is that of Broadway to the average American citizen of to-day. Six other great highways led from the Eternal City into different parts of Italy, — the Via Latina toward the south, the Tiburtina and Valeria and Salaria eastward to the Adriatic, the Flaminia and Æmilia north-eastward to Milan and Trieste, the Aurelian and Via Cassia northward to Geneva and Luna. These were the seven great trunk lines of conquest and commerce. They were interlaced by a stupendous network of lesser ways or roads, which brought the shepherds of the lowlands and the mountaineers of the Apennines into fellowship, and gradually fused the numerous and divergent tribes of Italy into the Latin people. At a later period the resources of the Roman treasury were heavily taxed for the construction of those great military highways which, as the empire expanded, stretched themselves from Italy to all parts of the world as it was then known. Through the German forests into Gaul and the Iberian peninsula toward the undiscovered north, eastward even into Asia and westward in the distant isles of Britain the Roman military roads everywhere resounded to the tramp of Rome's ever-conquering legions. Two thousand years have by no means destroyed these indubitable tokens of national power. They were built from the spoils of conquered nations, and captive races toiled and died in their construction. They ran generally in straight lines and without much reference to gradients, for vehicles were few. Over these great thoroughfares hurried both horse and foot, bearing the Roman

eagles and Roman civilization to the ends of the world. Thus originated the proverb still in use that "All roads lead to Rome." Through the influence of these great avenues of communication the constituents of the empire were gradually fused into a homogeneous mass, in which the soldiers of the orient and of the occident vied together to extend the military and political power of the institutions of this imperial race. It has been said that the genius of a people is seen in its architecture. The Parthenon illustrated the bent of the Grecian mind toward elegance and beauty. The religious feeling of the middle ages expressed itself in great cathedrals. The consummate flower of Roman genius was its great military and commercial roads. "This people," says Dupuy, "did not look upwards. Its eyes and hands were fixed upon the earth. No one has ever held it with a stronger grasp."

The construction of the Roman road was marvelously perfect. It would not, indeed, suit modern conditions and requirements, but it was the road for armies and war and the commerce of that day. It set a great example, and taught the fundamental lessons out of which has been evolved the modern road. In strength and permanence it has never been surpassed, and in a few instances only has the modern world attempted to equal it. Its foundation was deeply laid in flat stone and carefully drained; above it lay a course of rubble or coarse amalgam, next came the fine concrete, while the surface was crowned with stone blocks beautifully fitted together. Thus it was practically indestructible. The road bed was well elevated above the adjacent land, was abundantly protected by stone parapets, and was bordered by numerous stone riding blocks for convenience of mounting by the cavalry, saddles being then unknown. Each mile of the great Roman road was marked to indicate its distance from the Roman Forum, and often, along with these, stood elaborate monuments, the gifts of great conquerors or of rich merchants and nobles. It is an interesting fact that our word mile comes from the Latin word meaning a thousand, a Roman mile, estimated roughly, being *millia passuum*, or a thousand

paces. Perhaps the Roman soldier took a longer stride than his modern comrade in arms; for the Roman mile, though shorter than ours, was 1,614 yards. Or perhaps the computation was made from his double-quick, which was of course longer than his ordinary route step. It is worth while to note how unlike in length are the miles of the modern world. The Norwegian mile is 12,000 yards, —almost seven times as long as that of the English-speaking nations, who fix it at 1,760 yards; the mile of eight of the European divisions exceeds 8,000 yards; Spain most nearly matches the Roman mile, with her 1,522 yards; Holland is the lowest, with only 1,094, that is, about five-eighths of an American mile; the unit of Italy is the nautical mile, or one-sixtieth of an equatorial degree, 2,025 yards.

English Roads.

In England after the Roman occupation was over the imperial roads were neglected, and gradually fell into decay. Through the middle ages, and even down to the middle of the eighteenth century, British roads were the worst in Europe. It has been stated that in 1736 even in London and its vicinity it was a two hours' journey from Kensington to St. James palace, and carriages were often mired even on the most frequented roads. When George III. came to the throne, in 1760, conditions were not much improved. Indeed, nearly all the great work which has resulted in giving the British Islands to-day one of the best systems of roads in the world did not seriously begin until after the opening of the nineteenth century. Macadam and Telford were the first to apply scientific principles in a large and successful way to the construction of roads; and to these men, more than to all others, is due the success of modern road building. The fundamental principle of both is thorough drainage. Telford paid much attention to the foundation for the broken stone. Macadam disregarded it altogether, contending that the sub-soil would carry any weight if made dry by drainage and kept so by an impervious covering. The Roman precedent of straight roads was abandoned, and easy grades were sought for, without much

reference to directness of course. The maximum gradient was fixed at one foot in thirty, for it was found by experiment that on level ground on a well-constructed road the draught was equal to one-thirtieth of the weight of the load, and that on a grade of one to thirty a horse had to exert twice as much force to draw up the load as on a level. It was also learned that a road of slight and frequent gradients was more favorable to the horse than a perfectly level one.

The rule for the modern country road in England is for a roadway from fifteen to thirty feet wide, outside that a path for passengers, next fences, then ditches. The road material is kept in place by shoulders of earth or sods. Surface drains connect the top drainage of the carriage drive with the ditches, which are deep enough to drain the foundations of the road. For ordinary traffic a depth of six inches of broken stone has been found sufficient; for the heaviest traffic ten inches will answer, if the drainage be perfect. Telford covered his broken stone one and a half inches deep; Macadam rejected all covering of the stone, which he required to be fragments of so small size that all would pass through a ring of two and a half inches in diameter.

Almost all the continental roads of Europe, especially of the western portion, are of excellent quality; those of France approach most nearly to the Roman idea; but in Switzerland and even in far-away Norway and Sweden we find some of the very best types of the modern highway. They have one feature which particularly impresses the American, — that is the fact that in the country they are not worked to any great width, and are maintained and kept at all times in perfect repair. Heaps of broken stone are frequently seen at the roadside, ready to be applied wherever there is the slightest indication of disintegration; and repairers are permanently allotted to specific sections, for the condition of which they are held strictly responsible.

American Roads.

It would hardly be possible to exaggerate the disgraceful condition of American roads during the greater part of the colonial period. To a large extent the earliest settlers adopted the Indian trails in establishing their lines of communication. These were mere foot paths through the forests, along which the Indians were accustomed to march in single file. They followed the most solid part of the country, and were, of course, in many cases very crooked, so that the ancient highways, especially in a broken country like New England, are far from affording the shortest possible route from point to point. Until the opening of the eighteenth century there were few wheeled vehicles in use for travel upon public roads. Heavy and clumsy carts were employed for farming operations, but not until 1692 were they employed in moving produce on the highways. All travel was on foot or by horseback.

The highway from the Connecticut River eastward from Hadley to Brookfield, Worcester and Boston was called the Bay Road, that is, the road to Massachusetts Bay. It was begun and named in the year 1661, and was the earliest link of communication between the central and more northerly river towns of Massachusetts and the capital of the province. In December of that year the inhabitants of the new settlement appropriated forty-five shillings "towards laying out a commodious way to the Bay by Nashaway," the Indian name of Lancaster; but the matter seems then to have been neglected, for in 1674 we find the county court censuring Hadley for not joining Northampton in laying out a way to Quabaug (Brookfield), and requiring Hadley to build a foot bridge over Fort River.

During the eighteenth century roads multiplied in New England and throughout the Atlantic States, but they were almost undeserving the name of highways. They were built on the surface, without any adequate drainage or much attempt at it, and for several weeks in the spring were practically impassable. President Dwight, in his "Travels through New England," emphasizes the difficulties of most

urban intercourse, and especially censures Rhode Island for its indifference and niggardliness, saying that the inhabitants seemed to be entirely unwilling to pay for good roads. This condition of things existed practically up to the time of the revolution, so that the movement of troops, artillery and supplies was a matter of utmost difficulty both to the patriots and the British.

With the advent of the new government under the Constitution, or at any rate very shortly after, the necessity for great roads and canals for the proper conduct of interstate commerce, and as means of public defence in time of war, began to be seriously felt by the government. The matter was especially agitated by Jefferson after he came into the presidency. In his second inaugural address, delivered March 4, 1805, he made a strong plea for public works, and for the application of the government revenues to the construction of these great public improvements. It is interesting to notice how much of the best public service ever rendered by Jefferson was in defiance of the principles which professedly governed his public career. His advocacy of the construction of government roads and canals at the public expense gave his enemies the opportunity to taunt him with inconsistency in adopting those imperialistic ideas which he had so loudly deprecated, while at the same time it imposed upon his supporters the difficult and unpleasant task of defending these inconsistencies. Later, his purchase of the Louisiana territory from Napoleon turned out to be the greatest piece of beneficent imperialism upon which the American government ever has embarked, or perhaps ever will embark.

Nearly two years later, in December, 1806, in his message to Congress, Jefferson again urgently pleaded the cause of good roads and canals. There was no public debt of any consequence. Gallatin, by his conservative and careful management of the treasury department, had practically provided for its entire retirement. There was prospect that the government would soon be enjoying a surplus from its revenues, and these Jefferson was exceedingly anxious to use in the manner before indicated.

The following quotation from this message indicates Jefferson's anxiety to begin this great work on the continental canals and roads: "The question now comes forward, to what other objects (besides payment of the public debt and national defence against anticipated foreign war) shall these surpluses be appropriated? . . . Shall we suppress the impost (duties) and give that advantage to foreign over domestic manufactures?" The president goes on to urge the continuance of the impost system, affirming that the patriotism of the people "would certainly prefer its continuance and application to the great purposes of the public education, roads, rivers, canals and such other objects of public improvement as it may be thought proper to add to the constitutional enumeration of federal powers. By these operations new channels of communication will be opened between the States, the lines of separation will disappear, their interests will be identified, and the Union cemented by new and indissoluble ties." The president no longer talked about a frugal government. He wanted at least one-third of the revenues to go toward the building of roads, canals and education. Gallatin, his secretary of the treasury, heartily seconded the recommendations of his chief. He was ready to set out in the construction of four great highways to the west. These were deemed necessary not only for the purpose of reaching the remote communities of Kentucky, Tennessee, Ohio and the country which was then beginning to be filled up in the great valley of the Mississippi, but it was also considered that nothing was so vital to the defence of a country in times of war as fine roads. They were planned at this time to Sacket's Harbor, Erie, Detroit, St. Louis, and thence to New Orleans.

During this period the great question of the constitutional right of Congress to appropriate the public funds for promoting internal improvements was vigorously discussed, — a question now settled by repeated applications of the right, though there will ever remain in the minds of close constructionists a serious question whether the right may be derived from either the express or implied powers of our national Constitution. In March, 1806, by a somewhat close

vote, Congress had passed an act appropriating $30,000 for beginning the construction of a great national road from Cumberland, Md., to the State of Ohio. Its opponents denied the power of Congress to make roads under the Constitution. To obviate this objection, the consent of Maryland, Virginia and Ohio, through which the road was to pass, was first required. For a long time this agitation continued, and the policy was opposed not only on constitutional grounds, but also on grounds of expediency. Its opponents urged the mischief likely to arise from local jealousies; from wastefulness, extravagance and improvidence in dealing with the public moneys; from the dangerous power thus given the federal government of furnishing a bribery fund at the expense of the whole Union as a means of unduly influencing, and practically bribing, the favored States. Jefferson intensely favored the proposed measure, and, when Congress passed the bill, gave it his ready sanction. So likewise to other similar acts passed by the same Congress, appropriating $6,000 for a road from Nashville to Natchez, $6,400 for another from the frontier of Georgia to New Orleans, and $6,000 for one from the Mississippi River to the Ohio.

In his annual message of 1808 Jefferson again returned to the same subject, and recommended that the surplus, which it was expected would soon begin to accumulate, should be diverted by Congress for these public purposes. He argued that liberal expenditures for roads, canals and rivers and education were the great foundations on which the prosperity and permanence of the Union might rest with security. He even went so far as to say the Constitution might, if necessary, be amended so as to permit such expenditures. At that time his plan of national improvements contemplated roads to the great rivers, — the Alleghany, Monongahela, the Kanawha and the Tennessee. He also had in mind the building of a great turnpike, to follow the coast from Maine to Georgia. Congress was asked to appropriate from the surplus $2,000,000 a year for ten years. But with these recommendations and ambitions of the administration Congress was not in full sympathy, and so road-building opera-

tions, for the time, languished. It was not until after Jefferson had gone into retirement, and Madison had reached his second administration, that Congress earnestly took up the subject.

In 1815 the indifference of the national Legislature of 1805 and 1806 to the subject of good roads had in large degree passed away, but Madison vetoed the act that Congress passed. At about this same period the Legislature of Pennsylvania gave $150,000 to aid the building of a turnpike to Pittsburgh; Ohio, in recognition of her admission to the Union, gave money to complete the Cumberland road to the one hundred and thirteenth milestone; and so the era of great national roads seemed at last to be fairly inaugurated.

In 1819, the early part of Monroe's administration, Mr. Calhoun, then secretary of war, made a report on roads and canals with reference to military operations. He urged a generous outlay of the public funds for these purposes, as affording not only security for military defence and transportation of mails, but also as certain to stimulate commerce and trade between the States; he urged that their construction would consolidate the Union and greatly increase its wealth. His practical suggestion was the employment of the regular troops in time of peace in road building. Congress so far approved that it appropriated $10,000 for increasing the pay of soldiers thus employed; $500,000 were also appropriated toward the further construction of the Cumberland road, — a project which not long after gained the important support of the great commoner, Henry Clay.

A striking feature of the remarkable progress in so many directions which distinguished the century just closed was the improvement in the condition of its roads. This became especially evident in the last half of that period in a number of the States. New Jersey, in particular, made very notable progress in this respect, and certainly our own State of Massachusetts has much to be proud of in what has been accomplished along these lines since the days of the civil war.

Highway Locations.

The origins of our Massachusetts highways are various. The location of the early colonial roads was largely a matter of accident. When the country was settled by white men there were well-defined Indian trails or foot paths which connected the Indian villages. These naturally followed the most eligible routes. In turn, these became the foot paths and horseways of the English settlers. In Hampshire County, which then included the entire western half of this State, there were no carriages in use until well into the eighteenth century, though I believe the use of sleds for travel over the snow and ice in winter had been borrowed from the Dutch by way of Albany. When wheel vehicles began to come into more general use, the necessity for wider and more satisfactory roads immediately arose. Highways began to be worked in a rude way, and answered passably for the passage of wagons and carts. A good many of the country highways now existing had their origin thus; that is, they were evolutions from Indian trails, through bridle paths and lanes for cattle up to wagon roads. As the necessity of the settlers required it, other routes began to be used, connecting the different towns. Few of these had any actual laying out at the beginning, but as the population increased many controversies arose over highways, especially as to the location of new ones, changes in the old ones, the building of bridges, establishment of ferries, and the particular points to which they should be directed.

Next to disputes over the settlement of ministers and the management of church affairs, the New Englander of the seventeenth and early part of the eighteenth centuries found no field so fertile for the cultivation of controversies as that of roads and road building. The celebrated Morton-Dickinson dispute with the town of Hadley over their alleged encroachments upon the highway of the East Precinct, now the town of Amherst, in 1746, lasted fifteen years, and involved in its various phases the action of referees, the county court, and finally the General Court itself.

The rule in New England towns was one main street, with cross-roads intersecting it or leading from it. Some of these were of unusual width and beauty. Illustrations of these are apparent everywhere in the valley portion of the Commonwealth, in Springfield, Northampton, Hadley, Deerfield, Greenfield, Northfield, Amherst, South Hadley, Chicopee and many others that might be named. Old Hadley Street, famous the world over, was copied after the broad street of Wethersfield, Conn., whence came a large contingent of the Hadley settlers in 1659. It is a mile long, running due north and south, connecting the extremities of a five mile ox-bow in the Connecticut River, quite level, and at the present day shaded with beautiful elms. It was originally laid out twenty rods wide, and house lots, all of equal size, were assigned to the sixty different "adventurers," as they were called, on either side. Each abutter was required to fence his own lot, and thus a common place of pasturage was created, in which cattle were securely enclosed. This street was subsequently narrowed to sixteen rods, which, I believe, is about its present width.

The East Precinct of Hadley, now the town of Amherst, was divided and assigned to the Hadley settlers by lot according to their several estates; and a curious feature of the laying out of the lands of the precinct was that it was divided into three divisions, separated by two roads running north and south, each forty rods wide, which extended in straight, parallel lines throughout the whole length of the town, some seven miles. The reason for this undoubtedly was that travellers might have the opportunity of seeking the most eligible spots over a wide space in passing from point to point. Thus brooks could be most conveniently crossed and swampy places and steep grades could be measurably avoided.

The settlement began about 1730. In 1754 the more westerly of these wide highways were reduced to twenty rods in width and the easterly to twelve rods; and in 1788 the highways of the town were again narrowed, some to six rods, some to four, the town selling the land to the

abutters and requiring them to pay for it. It is an interesting fact that the principal business portion of the town of Amherst, as well as most of the college buildings, are situated upon land which was originally included within the limits of one of these broad highways. The encroachments of settlers upon this public domain were constant and persistent, creating great bitterness of feeling between individuals, and involving in some cases deep lines of estrangement through entire communities. The Morton-Dickinson controversy, to which I have already referred, was a striking illustration of this early warfare.

Definition of a Highway.

Every way used by the public and upon which all the public have a right to travel is a highway. This includes carriage roads, bridges, equestrian paths, foot ways, and in its broadest sense comprehends even ferries and navigable rivers. A public square is a highway; so is a road closed at one end by private land or buildings. A city street and a country road are alike highways. The foot path, which we find on the country road alongside of, and close to, the beaten carriage way, is a highway. The sidewalk of a street, whether it be in the country or the city, is as much a part of the highway as the part travelled by teams. State roads do not differ in their legal character from local roads. The difference is only as to the source from which the money comes to build and maintain them, and to pay the damages for injuries sustained by travellers owing to defects in the highway.

How Highways are created.

Highways may be created by prescription: that is, by a use for travel on the part of the public for so long a time that the law assumes that there was an ancient grant or deed, or by a formal act of laying out on the part of the county commissioners or selectmen or of the State Highway Commission. They may be relocated and their boundaries may be fixed anew by the same authorities; and this rule

applies not only to highways that have been originally laid out by municipal or State authority, but as well to highways created by prescription.

Of course property taken for laying out or relocating highways must be paid for, and the damages caused by repairing or raising or lowering the grade of a highway may be recovered by the owner.

If a highway is founderous, or so far out of repair that it is impassable with safety to the traveller, he may proceed over the abutting land without being guilty of trespass, but this is not a right to be lightly invoked. Mere convenience will not warrant such a deviation. It must be a case of real necessity, and travellers are held to strict accountability in this regard.

Massachusetts State Highway Commission.

Ten years ago this winter our Legislature established the State Highway Commission, and gave it power to lay out, construct and maintain such State roads as they might determine the public necessity required. The wisdom of this legislative action has been amply justified by the excellent results attained. The object of this legislation was not only to increase the general facilities for travel in the Commonwealth, but also to afford the more thinly settled and less wealthy communities, which cannot afford to construct a first-class road, the benefit of at least one good highway. Not an inconsiderable incidental benefit from this law is the example of good road building afforded the towns, and the impetus thus given toward the betterment of all other highways. The whole expense of these roads is originally borne by the State, but one-quarter of it is ultimately repaid by the county where the road is located. The system is being introduced in a conservative manner, and its gradual extension year by year will bring an increasing number of miles of road within the control of the State. An annual appropriation of half a million dollars affords ample opportunity for the consummation of this great public improvement. The honest, prudent, intelligent and conservative attitude

of the Board, which is charged with the expenditure of this fund, is a guaranty that the annual appropriation will reach the maximum of its efficiency.

The importance to all our people, and especially to those engaged in agricultural pursuits, of the State highway act of 1893 and its amendments, which are now codified in chapter 47 of the Revised Laws, makes it appropriate on this occasion to speak somewhat at length on its more important details.

The whole business of the State highways is in the hands of a commission of three persons, who receive liberal salaries and are accomplished experts in their special work. They are required to devote their entire time to the business of the commission, and have suitable allowances made them for a secretary, clerk hire, engineers and other incidental expenses. One of their important duties is the collection of statistics relative to the public highways of counties and municipalities, and the conducting of such investigations as they may deem expedient. County and town officers are authorized to consult with the Board without charge, thus giving it really an educational function. It is required to prepare maps of the State, showing municipal boundaries, public ways and State roads so far as practicable, and to collate geological information for the purpose of determining where materials for road building may best be procured. It must also annually hold at least one public meeting in each county, for the discussion of questions relating to public ways. It is required to make an annual report to the Legislature. These reports deserve the careful attention of our citizens, for they are among the most valuable and interesting of our public documents.

The damages sustained by any person whose land is taken for the State highway are, in the first instance, assessed by the commission itself, and are to be paid by the State. But the owner may appeal to the superior court of the county where the land lies for an assessment by a jury. The construction of all State highways is under the supervision, and subject to the approval, of the commission itself, and the expenditure for roads is to be fairly apportioned by the

commission among the different counties. Not more than ten miles of State road are to be constructed in any one year, except with the written approval of the Governor and Council.

The commission are required to keep every State highway reasonably clear of brush, and shall, if practicable, cause suitable shade trees to be planted thereon, and may establish and maintain watering troughs along its route. No one is authorized to open such a highway, nor to place any structure thereon, nor to change or renew any structure which the commission may have suffered to be erected thereon, except under a permit from the Board: in other words, the Board is to exercise complete and permanent control over such a highway.

The Commonwealth is held liable for injuries sustained by persons while travelling on any State highway, arising from defects therein, under certain limitations of pre-existing laws, with the single change that notice of an injury must be given to a member of the Highway Commission or its secretary. No damages can be awarded for injuries sustained upon the sidewalk of a State highway, or during the construction of the highway; and the amount to be recovered in any case shall not exceed one-fifth of one per cent of the lowest valuation of the town, nor be more than $4,000.

Snow and ice on the State highway must be removed by the city or town where it lies, so as to render the road reasonably safe for travel. The police jurisdiction of the town is retained over the state highway. The town authorities are required to give notice in writing to the commission of any defect or want of repair. In an emergency, the selectmen may make any necessary temporary repairs without the approval of the commission.

Of the amount expended for repairs on State highways in any city or town, a sum not exceeding $50 a mile is charged to the town, and made a part of the State tax of such town. In the smaller towns, where there is no State highway, the public funds may be used by the commission in constructing and repairing ways in that town: but this is not the building of a State highway, nor does the commission have authority over it. Such a provision is of very great value

in thinly populated communities, which find the burden of keeping their roads in proper repair quite too heavy to bear.

The commission constructs and maintains only that portion of the State highway which lies between the lines of the sidewalks nearest to the centre of the way. The sidewalks, as I understand it, are to be constructed and cared for by the municipal authorities.

The title of the Commonwealth to lands taken for a State road is very strongly fixed by the 20th section of the chapter which provides that no length of possession or occupancy of the land within the limits of a State highway by the owner or occupant of the adjoining land shall give him any title thereto; and any fence, buildings or other obstructions which encroach upon the highway must be removed forthwith by the owner upon written notice from the commission, and in default of such removal the commissioners themselves may remove them and place them upon the adjoining land.

No State highway can be dug up for laying or placing pipes, sewers, poles, wires or railways or for any other purpose, and no tree is to be planted or removed or obstruction placed on the road, without the written permit of the commission and in accordance with its regulations; and any such work so done must be carried on under the supervision and to the satisfaction of the commission, and the entire expense must be borne by the parties having the authority to disturb the street. The commission are required to give suitable names to the State highways, and may change the name of any street or road which becomes a part of the State highway. The erection of suitable guide-posts along the road is enjoined, and drinking fountains may be established.

It will be noticed that many of these provisions have been derived from pre-existing laws; but the effect of thus bringing these topics prominently before the people in the highway act must have a salutary educational influence, in impressing them with a more thorough knowledge of the rights and duties pertaining to the citizen in connection with his use of the public highway.

Wide Tire Legislation.

A law passed by our Legislature in 1900 relating to tires of draught wagons is of importance enough to farmers to require attention here. A draught wagon or cart having iron or steel tires less than one and one-half times the diameter of the axle or shoulder thereof may not be used upon any public way, but no tire shall be required to be more than four inches in width. Where the axles are hollow, the tires must be not less in width than the diameter of the axle or shoulder. This law applies to all wagons and carts whose axles are two inches or more in diameter at the shoulder, and to all stage coaches, tally-ho coaches and other passenger vehicles, except cars, constructed to carry eight or more persons. The law, however, does not apply to wagons or other vehicles owned or used in this State prior to Jan. 1, 1902. Any person violating these provisions shall pay a fine of $100.

In view of the wide latitude given as to the wheels of vehicles in existence prior to the beginning of the current year, it is quite likely that we shall have by and by a good many wagons and carts that will vie in antiquity with Dr. Holmes's famous old one-horse shay; for I take it that repairs will be made upon such wagons until finally it will turn out that no part of the original wagon remains. Or it will be the case of the jack-knife over again, which had been so thoroughly repaired in every respect that not a vestige of the original knife was left. However, if not perfectly enforcible in consequence of this limitation, the statute is a very wise and beneficial one, and must commend itself to the notice of all who love to see good roads kept in good order and well preserved.

Defects in Highways.

If a person travelling on a highway is injured or loses his life because of a defect therein, the town, city or county or person required by law to keep it in repair is liable, if reasonable notice of the existence of the defect has been given, and if the defect might have been remedied by the exercise

of reasonable care. In the case of State roads, the Commonwealth itself becomes liable for such defects; but by a statute passed in 1896, no county, city or town is liable for an injury caused solely by snow or ice on the highway, if it is otherwise reasonably safe. In case of injury, notice must be given within a certain time thereafter to the party liable; and under the present statute the amount of recovery is limited to $4,000 for any injury and $1,000 in case of death. This limitation was created some years ago by the Legislature, in consequence of the difficulty experienced by the small towns in paying adequate damages in cases of extraordinary accidents.

It is quite immaterial to a recovery of damages that the defect was caused by the wilful or negligent act of a third person. A town that is bound to keep a road in repair is bound to remedy the defects, however caused. If the injured person knows of the defect, and of the risk he is taking in using the highway under such circumstances, he will be held guilty of contributory negligence, and so cannot recover. If a traveller on the highway loses complete control of the horse he is driving, and that loss is not merely momentary, he cannot recover, though the way is defective, if he receives an injury.

Formerly, one who was travelling merely for pleasure on Sunday and was injured by a defect in the highway could not recover, because his own unlawful act was held to be contributory to the injury; but in a later case the court drew the somewhat narrow distinction that if a pleasure traveller was injured by a dog on Sunday he could recover against the owner of the dog. This case has been put into verse, and dealt with thus humorously (see White *v.* Lang, 128 Mass): —

> Now, J. P. Lang a dog possessed,
>   As many dogs you find,
> Whose bounden duty thought it was
>   To bark at all mankind, —
> To bark and growl and eke to bite
> Each passing steed or luckless wight.
>
> . . . .

Thus runs our tale: the dog of Lang
 Rushed forth with dreadful roar,
Swift at the horse's head he sprang;
 Away the courser tore,
The buggy dashed upon the ground
And dire ruin spread around.

Then White good counsel did procure,
 Commenced a suit in tort,
And prayed for judgment swift and sure
 In the superior court;
The damage done doth also pray
That J. P. Lang two-fold must pay.

"Not so," defendant cries, with spite;
 "Whate'er your rights might be,
You are a Sabbath-breaking White, —
 No cash you'll get from me.
The law doth clear and surely say,
On Sunday you shan't work or play."

"That nought avails," retorted White,
 "For, sinner though I be,
To punish me with canine bite
 Is not allowed to thee.
Go to thou overweaning elf;
I'll answer for my sins myself."

. . . .

This view the learned court sustained,
 To plaintiff's great delight;
Defendant, too, was deeply pained
 To lose his shekels bright,
To serve brave White, if need befall
Promptly to pay his fine withal.

. . . .

In foro conscientiæ,
 Or e'en in police court,
Let Sabbath-breakers punished be,
 And good behavior taught;
But they have rights which must, I ken,
Respected be by dogs and men.

The Sunday laws have been greatly relaxed in later years. In fact, since 1884, any person travelling for pleasure on Sunday when injured by a defect in the highway may recover his damages.

It is important for the traveller to understand that it is only that portion of the road used for travel that must be kept free from defects. If the wayfarer drives on the untravelled portion of the road, he ordinarily does so at his peril; so that, if a traveller on foot where a sidewalk is provided walks outside the limits and is injured by a defect, he has no redress unless his progress on the sidewalk was somehow impeded, or unless it was out of repair.

If there are dangerous objects so near the travelled portion of the road, however, as to be likely to cause injury, they will be classed as defects, unless a suitable railing or fence protects a traveller from inadvertently straying on them; but it has been held that a dangerous place twenty-five feet from the travelled road is not in such proximity to it as to require a protection.

It is only *travellers* on the highway who can hold a town responsible for defects. If a horse and carriage are hitched outside the highway, and the horse gets loose and runs away on the highway, and the horse or the carriage is injured by a defect in the road, there can be no recovery. The fact that the plaintiff is playing in the street is usually a defence in an action to recover damages.

Ownership in the Fee of the Highway.

The right of the public in highways is only an easement, subject to the rights of the abutters or the owners of the soil on either side, the owner holding title to the middle of the road. The right of the public is sufficiently broad to protect all individuals in the legitimate use of the highway, but such right extends no further than this. Beyond that the public cannot go, or they are guilty of trespass against the abutters if they do so. What is a legitimate use of the highway is a question that has caused a great deal of litigation. The difficulty is, to apply the general principles to the particular case in hand. Of course walking, riding or driving over the highway constitutes a legitimate use of it. Running a steam railroad over it would not be, and the abutters would have the right to complain about it. It is now settled everywhere that the use of the highway to support telegraph, telephone and electric light poles is legitimate; also that

electric railways may be built thereon under municipal direction, and with the consent of the proper boards, for local passenger accommodation. The modern extension of this doctrine was strenuously resisted somewhat less than ten years ago by certain inhabitants of the city of Cambridge, who contended that the public easement in the streets did not include the carrying by the abutters of so serious a burden as the passage of electric cars over the street involved; but our supreme judicial court took the opposite view, holding that it was not an unreasonable extension of the easement under existing modern conditions.

Authority may also be given municipal boards to lay water, gas and sewer pipes in the street; also wires for conducting electricity and tubes for the pneumatic mail service; but all these things must be done under proper orders and regulations established by the municipal authorities.

In so far as these uses of the highway prevent other uses of it, the abutting owner's practical advantages from his ownership of the legal title to the soil of a highway are very essentially diminished, yet for this diminution he seems to have no redress.

Most of what I have just been saying on this subject applies of course to the streets of both cities and towns. But in the country it frequently happens that the whole highway is not needed for highway purposes. Wide borders on either side the travelled way may be covered with grass, or trees may be growing there. Of late it has become the fashion to lay out boulevards with a reservation for the street railway and equestrian paths in the centre, and travelled portions on either side.

The abutter may take such advantage as he can of the growth of grass or of the trees along the highway. He may cut the grass; he may pick the fruit from the trees. He may forbid others to do these things, and sue them in trespass if they infringe his rights in this respect. I am told that in New Hampshire there have been seen notices by abutters on berry bushes growing wild on the side of a road, forbidding the public from picking the berries. The owner was undoubtedly within his legal rights; but it would probably be very hard to find a Yankee jury that would award any very

substantial damages against a passer-by who chose to ignore the warning, and picked the fruit.

Unless forbidden by town ordinance, the owner may pasture his cattle on the side of the road; but as this is likely to cause accidents by the straying of the cattle over the travelled portion of the road, and thus to interfere with the use of the road by the public, the Legislature has authorized towns to pass ordinances prohibiting it.

But an abutter cannot complain if by the increase of legitimate use on the part of the public his enjoyment of the highway is gradually diminished. If the selectmen of a town conclude to lay a sidewalk where there has been none before, and by so doing diminish or destroy the crop of hay the abutter has been accustomed to cut, he has no remedy.

The opening of the street for gas and water pipes, the erection of telegraph and telephone poles and the location of street railways in roads and streets are all illustrations of the power of municipal authorities to limit and diminish the value of the abutter's ownership of the land over which the road is built.

A curious case arose in Vermont some years ago, where an abutter was able to enforce his rights in rather a remarkable way. The defendant's children, going to school, got their clothes wet from the grass growing between the horse paths and wheel ruts. With the highway surveyor's consent, the defendant cut the grass, carried it away and fed it to her husband's cow. The plaintiff, the abutting owner, sued, and the defendant was held liable. She might rightfully cut the grass, the court said, but she was liable for appropriating it after it was cut.

Obstructions.

No person, whether an abutter or otherwise, is allowed to obstruct the highway. Anything which materially encroaches upon the highway is a nuisance, and may be abated notwithstanding space is left for the passage of the public. The adjoining owner may use a highway temporarily, or for a reasonable length of time, for loading or unloading goods

or for depositing building material under proper municipal regulations; but if such use is prolonged for an unreasonable time, or if it is of such a nature as to unnecessarily or unduly interfere with the right of the public to pass and repass, it will constitute a nuisance, and may be abated.

The most common forms of encroachment in the country are the gradual pushing out of fences beyond the line of the highway into the highway itself; making the street a dumping place for refuse of all kinds; filling up the sides of it with stone; piling it with lumber; using it for the storage of wagons, carts, etc., — thus rendering it unsightly, and in some cases unsafe for travel. We find references in the town histories to the practice of throwing manure from stables into the streets, — a nuisance not to be tolerated, of course. Judd's "History of Hadley" mentions the fact that Oliver Smith used to throw his manure out into the broad street opposite the meeting house, much to the discomfort and disturbance of all who worshipped there on Sunday.

Any unauthorized obstruction of a highway is a public nuisance, and creating or maintaining a public nuisance is a criminal misdemeanor. The normal remedy for such a nuisance is a criminal prosecution. Sometimes an additional remedy is allowed by an injunction granted at the suit of the Attorney-General.

A private citizen who is especially injured by an obstruction in the street may also apply for an injunction. This is one of the rare cases in the law where an injured person may take the remedy into his own hands, and have the nuisance abated. It was said by the former Chief Justice Shaw of Massachusetts, in an important case, Brown *v.* Perkins, reported in 12 Gray, that the true theory of abatement of nuisance is that an individual citizen may abate a private nuisance injurious to him when he could also bring an action; and also when a common nuisance obstructs his individual right he may remove it, to enable him to enjoy that right, and he cannot be called in question for so doing; as in the case of an obstruction across a highway, and an unauthorized bridge over a navigable water course, which water course

he has occasion to use. He may in that case remove the unauthorized bridge, by way of abatement; but this would not justify strangers, being inhabitants of other parts of the Commonwealth, having no occasion to use it, in doing the same thing.

But this private right of abating nuisances cannot be exercised under such circumstances that it would involve a breach of the peace. Care must always be taken to do no more injury than is required to remove the obstruction; and, although it may be necessary, in order to abate a nuisance in the highway, to remove materials therefrom, the person abating the nuisance is not justified in converting those materials to his own use.

The Legislature may, by authorized obstructions in the highway, legalize what would otherwise be a nuisance; and a municipality may have conferred upon it, by the Legislature, similar power. Street railway tracks are an illustration of this doctrine. In the case of a steam railroad crossing a highway at grade, the Legislature has defined when it shall be a nuisance for the cars to stand across the road and obstruct it, by forbidding such obstruction for more than five minutes at a time. The Legislature has in effect authorized the obstruction thus long, while forbidding it to any greater extent.

If an individual creates a nuisance by obstructing a highway, and the town is held liable to a third person who is injured because the town failed to keep the road in repair, the town may afterwards sue the original wrong-doer for the damages which the town has been compelled to pay. That is to say, a person injured may perhaps have a remedy either against the individual who caused the obstruction, or the town itself, and he may elect against which he will proceed. If he succeeds in having the town mulcted in damages, the town may in turn sue and recover from the person originally causing the injury.

The purpose of the highway is to accommodate the public travel, whether on foot, horseback or in vehicles, and to facilitate commercial intercourse. It certainly is not a necessary incident of its usefulness that it should provide pas-

sage for trained bears or the driving of other wild beasts, whether caged or not; and so the statute forbids their passage except in covered wagons or cages.

In the case of Gregory *v.* Adams, in 14 Gray, we have an account of an elephant belonging to a menagerie, which broke down a bridge when he walked over it. The question was raised in that case whether he was a proper traveller on the highway; and the supreme court sustained the position of the lower court, which held it was a question for the jury to determine whether the elephant was a proper traveller or not.

Individuals may so conduct themselves as to be trespassers on the highway. Boisterous and riotous behaviour may go so far that participants in it may lose their rights as legitimate travellers upon the highway, so as to be liable to persons offended for a disturbance of the peace, or so as to disqualify themselves from recovering damages while acting in such unlawful manner.

An interesting case arose a good many years ago in the State of New York, which illustrates the extent to which courts will go in affording protection to persons annoyed by trespassers. The opinion says: "The defendant also committed a trespass while standing on the sidewalk by the plaintiff's lot where he lived, and using towards him abusive language. While so engaged he was not using the highway for the purpose for which it was designed, but was a trespasser. He stood there but for about five minutes. It was not shown that he stopped on the sidewalk for a justifiable cause; on the contrary, it was rendered probable that it was for a base and wicked purpose. It was therefore a trespass. Suppose a strolling musician stops in front of a gentleman's house and plays a tune or sings an obscene song under his window, — can there be a doubt that he is liable in trespass? The tendency of the act is to disturb the peace, to draw together a crowd, and to obstruct the street. It would be no justification that the act was done in a public street. The public have no need of the highway but to pass and repass. If it is used for any other purpose not justified by law, the owners of the adjoining land are re-

mitted to the same rights they possessed before the highway was made. They can protect themselves against such annoyances by treating the intruders as trespassers."

Trees on Highways.

At common law the abutting owners upon highways own the fee in the land to the middle of the street, subject to the public right of travel, and trees planted or standing along the highways and affording shade still belong to the owners of the land. Highways in this Commonwealth were early entrusted to the care and control of the highway surveyors, and among their responsibilities and rights was the duty and power to cut down or lop off all trees and bushes which hindered, incommoded or endangered public travel.

In 1856 an act was passed authorizing the planting of shade trees on the highways, and providing that the trees so planted should be deemed the property of the person so planting them, and should not be deemed a nuisance; and also providing that, upon complaint to the mayor, aldermen, selectmen or road commissioners, they might cause such trees to be removed, at the expense of the owner thereof, if the public necessity seemed to require it. That act also contained provisions imposing penalties upon persons injuring, defacing or destroying ornamental or shade trees in the highway. In 1885 the power of the person appointed to have the care of the trees in the town, and to trim and cut down trees in the public way, was limited so that he should not be allowed to cut down such trees without an adjudication of the mayor, aldermen, selectmen or road commissioners. There were other provisions in the statutes authorizing appropriations by towns, to be expended in setting out and caring for shade trees in the public highways.

Tree Wardens and Foresters.

In 1896 the Legislature established for the first time the office of tree warden, and provided that towns might annually elect such an officer, who should have charge of all the public shade trees in the town, including the expenditure

of the public funds appropriated for setting out shade trees; and providing, further, that he might order the removal of such shade trees or of such parts thereof as he might determine to be for the best interest of the public, after hearing the parties. This law further provided that no tree warden or other person should cut down, remove or injure any live public shade tree until after a hearing of all parties interested.

In earlier statutes there had been provisions authorizing towns to take land for forestry purposes and cultivate the same, and other provisions designed to secure the protection of forest land against fires. In 1897 an act was passed by the Legislature providing that, in towns which should accept the provisions of the act, the selectmen should annually appoint a forester, who should have the power and duties of a tree warden with respect to the public shade trees in the limits of the highways and other public places, and who should also be the chief forest fire warden in such town, and take precautions to prevent the setting and progress of forest fires, and so on.

It will be seen, therefore, that after the enactment of this law all towns might annually elect tree wardens, who should have the charge of the public shade trees; and such towns as accepted the provisions of the act might have foresters appointed by the selectmen, who should have the duties of tree wardens in addition to their other duties: that is, there was no obligation upon any town to elect tree wardens, and there was no obligation upon any town to appoint foresters, except in those particular towns which duly accepted the act of 1897.

In 1899 the Legislature passed another act, entitled "Codification and amendment to laws relative to the preservation of trees." That act provided that every town should annually elect a tree warden, who should have the care and control of all public shade trees, and expend all funds appropriated for the setting out and maintenance and prescribe regulations for the care and preservation of such trees. Other provisions were, that whoever, other than a tree warden, desired the cutting or removal of any public

shade tree, should apply to the tree warden, who should give a public hearing thereon; and that a tree warden might cut down or remove trees outside the residential limits of the town without such hearing, if he deemed it necessary. This act also contained penalties against destroying or injuring trees by driving beasts against them, or by affixing notices to them, or in any other manner.

In the Revised Laws, which were passed in 1901, all the provisions of the act of 1899 are retained; but the only reference to the forester is found in a single section of chapter 53, section 14, which is to the effect that in towns which had already accepted the provisions of the earlier acts, or which might accept the provisions of this section, the selectmen are required to appoint a forester, who shall have charge of all trees except public shade trees within the limits of the highway or other public way.

As the law stands, therefore, to-day, in towns the care of the public shade trees in the highways or in other public ways or places is in the control of the tree warden, who is a town officer, and must be elected annually by every town. It is his duty to preserve the trees from injury, including injury by insects, and to make proper regulations therefor.

The tree warden is given considerable authority. He may appoint and remove deputy tree wardens. While he does not under the law have jurisdiction over trees in public parks, still, the Park Commissioners may, if they see fit, transfer to the tree warden the care and control of all public shade trees in the parks. He expends all the money appropriated for setting out and maintaining public shade trees. With the approval of the selectmen, he may make regulations for their care and preservation which will have the force and effect of the town by-laws. The statute also enacts that all shade trees within the limits of the public way shall be public shade trees.

No person has any authority to cut or remove in whole or in part public shade trees outside the residential part of the town, except the tree warden or his deputy or some person licensed by the tree warden. Public shade trees within the residential part of the town are amply protected. The tree

warden has authority to trim them; but no person, tree warden or otherwise, has any authority to cut them without a public hearing, notice of which is to be given by posting in two or more public places in the town and upon the tree itself, and after authority granted by the tree warden.

Arbor Day.

An interesting enactment made in 1886 may here properly be mentioned in connection with the subject of trees. I refer to the Arbor Day act, so called, which provides that the Governor may annually issue a proclamation, setting apart the last Saturday in April as Arbor Day, and recommending, among other things, that it be observed in the planting of trees, shrubs and vines for the adornment of the public grounds, places and ways, in such other efforts and undertakings as shall be in harmony with the general character of such a day. This effort to promote the beautifying of the highways by planting of shade trees has not received the recognition and attention that it deserves. There is need of creating a public sentiment which will lead to a general observation of the duties of this day by the owners of property upon streets and roads. There is no better investment for inhabitants of a town than well-shaded avenues for travel. Roadside trees are no inconsiderable element in the preservation of a roadway. It is true that they somewhat delay the settling of country roads in the spring, but when the towns learn better methods of constructing roads, this objection will be obviated. A well-shaded road makes the work of the heavily laden team easier, and greatly enhances the delight of the man who is travelling for pleasure. A town whose streets are to an exceptional extent lined with shade trees, well tended and cared for, is sure to secure many summer visitors, and some permanent residents, who are attracted by this very inexpensive but beautiful feature of country life. If every land owner in any town of this Commonwealth could be induced to set out and maintain trees along his whole frontage, that town in fifteen years would be a place of exceptional interest, and would find such tree culture the very best investment it could possibly make. Why

cannot our village improvement societies zealously take up this subject? Let us see if we cannot find one municipality in Massachusetts that is ready to enter upon such a crusade of tree planting.

The Legislature has very wisely provided that towns may furnish the means for such a work. Among the various objects for which municipalities may appropriate money at legal meetings, we find the authority to raise an amount, not exceeding fifty cents for each of its ratable polls in the preceding year, for planting shade trees in the public ways; or at the discretion of the tree warden, and with the written consent of the owner of land adjoining such ways, at not more than twenty feet from the way, for the purpose of shading and ornamenting the roads.

It is a matter of congratulation that injuries to shade trees in the highway by men or animals are severely punished; for section 103 of chapter 208 of the Revised Laws, following the statutes of 1859 and 1899, provides that whoever negligently or willfully injures or defaces or suffers any animal driven by him or for him or belonging to him, even if it be lawfully on the highway, to injure, deface or destroy a tree which is not his own, standing for use or ornament on the highway, may be fined not less than $5 nor more than $100, one-half of which goes to the complainant and one-half to the city or town. Besides that, the offender becomes liable to pay damages to the owner or tenant of the land in front of which the tree stands. This ought to be enough to prevent the persistent horse hitcher from making a post of every tree that suits his convenience.

Endowment of Roads.

It is perhaps not generally known that savings banks, under the provisions of the acts of 1875 and 1895, are especially authorized to receive on deposit, to any amount, funds in trust for the purpose of setting out shade trees in streets and parks and for improving the same; and also for erecting and maintaining drinking fountains in public places.

These funds are placed on interest in the banks, the dividends being payable semiannually to the town designated

by the donor, and are to be expended by the authorities of the town for the purposes specified. No part of the principal can be withdrawn, and the same is exempt from attachment or levy on execution.

Here we have a legislative sanction for the creation of trust funds to be used in beautifying highways.

I am not informed to what extent funds have been deposited in our savings banks for these purposes, but the legislation certainly is a step in the right direction. Let us hope that out of it may finally grow the habit, on the part of our rich men, of providing a permanent fund for the embellishment and beautifying of our public places. One can hardly conceive a direction in which benevolence could be more usefully exerted than in the gifts of large sums of money for the rebuilding, relocation, regrading and rendering more convenient and beautiful the roads of the country town. Men of great wealth have given and are giving enormous sums of money for the endowment of schools and colleges, for scholarships, fellowships, lecture courses, the erection and support of libraries, and for many other such like useful and salutary purposes. There is even talk of having endowed theatres. No one of these meritorious claimants makes a stronger case than the neglected road and roadway. How fine a gift it would be for a loyal son to bestow upon his native town a handsome and expensive stone bridge, which might bear his name, and stand as a permanent memorial to his generosity. What could be better than for such an one to set aside a large fund for the improvement and beautifying of the street or road passing the house where he was born, and over which he travelled to school or to mill during the years of his boyhood? This might well include not only the construction and maintenance of the best form of modern roadway for vehicles, but also the sidewalk, bridle path, planting of trees, cutting the grass, watering the road, and perhaps even the lighting of it. Such a benefactor might well expect the street to take his name. What community is there that would not delight to reward such beneficence with so slight a recognition? Upon such a highway so constructed and maintained, or upon the hand-

some bridges which might span its water courses, one would look to see memorial tablets, preserving the record of notable events in local history, and monuments to the distinguished sons of the town. Would that we had a Carnegie road builder, as well as a Carnegie library builder! I cannot but believe that, if some gentleman of wealth would lead the way in such benevolence as this, many others would arise out of our various communities to imitate his example, and distribute of their abundant wealth along these lines. I have in mind one community in the Commonwealth which has been favored in this direction by the bestowal of considerable sums by a native of the town to improve the condition of her roads, but I know of no case where there has been an endowment for the purpose.

Objections have been made in certain quarters to large endowments in any direction. It is thought by some that the great universities of our country are absorbing more of our accumulated wealth than single institutions can profitably use. Most men believe that it is unwise to endow churches. I do not sympathize with either of these views. On the contrary, I do believe that the outlets of charity may be profitably enlarged, so as to reach and greatly benefit that immense system of inter-communication which binds our communities together and makes them neighbors to each other. No bestowal of benevolence would be more far-reaching and permanent and beneficent in its results and influence than the endowment of our public roads. I should feel amply repaid for the preparation of this address, if I could believe that this last suggestion would reach and influence some one of our numerous American millionaires to lead off in establishing by liberal endowment a well-considered trust for the inauguration of the coming era of improved and beautified American roads and roadsides.

Mr. A. A. Smith (of Colrain). Recognizing that no one has a right to mutilate shade trees or trees by the roadside, yet knowing there are numberless firms going about the country nailing up signs which deface the landscape, without any consent from the selectmen or from the tree warden, I

would like to ask if a committee appointed by the local improvement society could remove them, or would they need the permission of the tree warden?

Mr. Dickinson. I should think that under the law the tree warden is charged with that duty. I do not know as the law goes specifically into that subject, but I think his authority is broad enough to warrant the removal by him of the defacing emblems, and he may probably depute that duty to a committee of the improvement society as his deputies.

The Chair. Did I understand you correctly, in referring to the law, to say that no one has a right to cut any tree down except the tree warden?

Mr. Dickinson. All trees which are public shade trees; that is a weakness in the law. I presume any tree warden would give authority to the owner to cut all trees he wanted to remove, in case of a wooded tract adjoining the highway.

Question. Is there any priority of right in the highway between the pedestrian, a carriage, a trolley car or an automobile?

Mr. Dickinson. You are asking a difficult question. Every one of those would have to be decided according to circumstances. I think it is always a question of fact. The rights of pedestrians are more carefully guarded in Massachusetts than almost anywhere. The law is that the highway belongs to the public, and all have equal rights. The street car has equal rights with other travellers, but is confined to a certain location; within that location it has a right to move with reasonable despatch, but it cannot run down a person. The only way is to apply the golden rule, and do as we would be done by.

Question. Has the surveyor any right to trim trees that would interfere with public travel? Of course he has a right to cut to a certain extent, — but fruit trees, for instance?

Mr. Dickinson. That is a difficult question. I have not examined the law in regard to public surveyors, as to what their rights are. If the surveyor finds that it is necessary to public safety to cut certain trees, I should advise him to go ahead. If it becomes necessary, for the passage of high

wagons, to remove branches of trees, I think the surveyor has a right to do it.

Mr. ——. I understand he has the right to, and is liable to a fine if he doesn't do that.

Mr. Dickinson. I presume any tree warden, in consultation with the surveyor, would come to the same view of it.

Mr. J. G. Avery (of Spencer). Would it be unreasonable to require that automobiles be numbered as they come from Boston, and have "Boston" on them, and be registered in Boston with that number, so that when they pass me on the street I can see the number and the place of registration? The State roads make fine places for the automobiles, and when they are going at a fast rate they don't want to slow up for me when I am driving. Last week I was out driving, and my horse, which was never afraid before, was frightened that time.

Mr. Dickinson. I would join in that recommendation. I believe there will be a great improvement soon. The situation is very much as it was with the bicycle, before the public had learned to adjust itself to it. I certainly think if there were some way of identifying automobiles it would be well.

Question. What rights have bicycles in the highway?

Mr. Dickinson. I think those are regulated by municipal by-laws. They have the right to be on the highway, but not on the sidewalk. I think they are excluded in all cases from sidewalks. Their place is on the highway.

Question. Has it not been decided they are machines, instead of vehicles?

Mr. Dickinson. I think it has been decided otherwise.

Mr. G. M. Whitaker (of Boston). In case a town widens her highways or rebuilds them, or constructs a sidewalk on the highway, does that work put in the hands of the highway surveyor certain rights as to shade trees? So far as that work is concerned, does it supersede the work of the tree warden?

Mr. Dickinson. I should think so. It would be absurd to say that the tree warden, whose office is to preserve shade trees for beautifying the road, should have his office so mag-

nified as to defeat special work of the town in improving its roads. The action of the town would take entire precedence, I should think, over the right of the tree warden in such a case.

QUESTION. Has the public surveyor a right to trim shade trees on the side of the road, and make them look like bean poles?

Mr. DICKINSON. I don't think so. That is the tree warden's business. The surveyor has the right to do what is necessary to make the highways safe for public travel, but not to go beyond that.

Mr. ——. As to the rights of the abutter as far as the middle of the road, in your opinion, if the tree warden should decide that on one side of the street it was for the public benefit to cut the trees growing there, public shade trees, has he the right to do that, and can no one interfere?

Mr. DICKINSON. I think the law gives him that authority under certain limitations, but it would be an exercise of bad judgment thus to do.

Secretary STOCKWELL. But the man may do an injury that would remain for twenty-five years, before you could turn him out at the end of the year. I think it is a question of very great moment in all sections of the State. We have been trying for two years to make a law that will be satisfactory to all parties. The tree warden should not have such absolute power that his taste and judgment shall decide for a year what shall be done, so that he may change the aspect of a street. He, perhaps, might have peculiar taste, so that he would injure a street for many years. In the second place, the law should be so amended that the abutter shall have a right to be interested in his own land. His individual taste should be consulted in connection with it.

Mr. DICKINSON. I think that is an important matter. The rights of the abutter are not quite fully protected by this tree warden law. I think it should be provided that the tree warden should not remove any tree until he has the consent of the abutter, and if they disagree about it, that the selectmen should settle it.

QUESTION. If a tree warden should remove a tree, has he the right to sell that wood, or does it belong to the abutter?

Mr. DICKINSON. To the abutter.

Mr. REED. I would like to ask regarding the rights of a man driving a herd of cattle, meeting an electric car.

Mr. DICKINSON. It would take more of an expert than I am to answer that. I should think it would be the duty of the motorman to stop his car until the herd got by. I should say that was the only rule of safety. Driving cattle in the streets is perfectly legitimate. They cannot be controlled as horses can, and I think the motorman ought to stop and let them go by.

Mr. HARRISON. In regard to electric roads, they have no right, as I understand it, to pass feed wires in through the branches of trees, unless insulated. There is a long avenue of maples past my place, and every once in a while a live wire gives out electricity and burns the tree. They sometimes have girdled a tree with wire.

Mr. DICKINSON. That is a case where a man has a right to stop a nuisance. Companies frequently disfigure trees by lopping off branches unnecessarily.

Mr. HARRISON. Is there compensation for that?

Mr. DICKINSON. If they interfere unnecessarily with the tree so as to cause its destruction, I think the abutter might claim and receive compensation.

ANNUAL MEETING

OF THE

Board of Agriculture

AT

BOSTON.

January 13 and 14, 1903.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 13, 1903, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by Secretary STOCKWELL, who, in the absence of a presiding officer, invited Mr. W. A. Kilbourn, chairman of the executive committee, to take the chair.

Present: Messrs. Allen, Anderson, F. H. Appleton, J. S. Appleton, Avery, Barton, Boise, Bowditch, Bradway, Brewster, Bursley, Clark, Comins, Damon, Danforth, Ellsworth, Gurney, Hersey, Jewett, Kilbourn, Lyman, Peters, Reed, Richardson, Sargent, Sessions, Smith, Spooner, Stockwell, Thayer, Turner and Wellington.

Gen. F. H. Appleton, senate chairman of the committee on agriculture of the Legislature, gave notice of a hearing to be held by that committee at 12 M. Wednesday, to consider the subject of the foot and mouth disease among cattle, and invited the Board to appear as a body or by committee at that hearing. The executive committee was by vote authorized to represent the Board in the matter.

The report of the committee on Massachusetts Agricultural College, on the matter of producing vaccine lymph at the said college, referred to this committee at the special meeting of the Board on July 22, 1902, was presented and read; and after brief discussion, it was

Voted, That the report of the committee be accepted and adopted, and transmitted to the General Court with the recommendation that an appropriation be made for the purpose.

An abstract of the annual report of the secretary was presented, read and accepted.

First Vice-President Sessions, coming in, took the chair.

Reports of committees being in order, Mr. Kilbourn, chairman of the executive committee, reported progress in the matter of revision of the statutes, by-laws, etc., and asked for further time, which was granted.

The committee on gypsy moth, insects and birds, by Secretary Stockwell, presented a written report, which was accepted and adopted as the report of the Board of Agriculture to the Legislature.

At 12.30 o'clock the Board adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. Kilbourn in the chair.

The first annual report of the State Nursery Inspector, Dr. H. T. Fernald, was presented and read by the secretary, and accepted by vote of the Board.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted.

The report of the Dairy Bureau was read by the general agent, Mr. Whitaker, and accepted.

The committee on experiments and station work, by Mr. Spooner, chairman, presented a written report, which was accepted.

The committee on forestry, roads and roadside improvements, by General Appleton, chairman, presented a written report, which was accepted.

First Vice-President Sessions, coming in, took the chair.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted.

The report of the librarian was read by the secretary, who moved that the historical matter submitted by the librarian be referred to a special committee of three, to include the Chair. The motion having been seconded and carried, the Chair appointed President Goodell and the secretary to serve with him. The report of the librarian was then accepted.

The second semiannual report of the chief of the Cattle Bureau of the Board was presented and read by Dr. Peters, and accepted as the annual report to be printed.

The committee on domestic animals and sanitation, by Mr. Damon, chairman, presented a written report, which was accepted.

The committee on institutes and public meetings, by Mr. Sargent, chairman, presented a written report, which was accepted.

Mr. Kilbourn, for Mr. Goodspeed, extended an invitation from the Worcester Northwest Society to the Board to hold its next public winter meeting at Athol. The matter was referred to the committee on institutes and public meetings.

An abstract of the reports of inspectors of the several fairs, prepared by direction of the committee on agricultural societies, was read, and the reports of inspectors were accepted by vote of the Board.

At 5.15 the Board adjourned to 10 A.M., Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President Sessions, at 10 A.M.

Present: Messrs. Allen, Anderson, Appleton, Avery, Boise, Bradway, Brewster, Bursley, Burt, Damon, Danforth, Ellsworth, Goodell, Goodspeed, Gurney, Hersey, Jewett, Kilbourn, Lane, Lyman, Perham, Reed, Richardson, Sessions, Shaylor, Smith, Spooner, Stockwell, Taft, Turner and Wellington.

The records of the first day were read and approved.

The executive committee, as committee on credentials, by Mr. W. A. Kilbourn, chairman, reported the list of qualified members of the Board for 1903. The newly elected members by the several societies are as follows: —

Amesbury and Salisbury, John J. Mason of Amesbury.
Blackstone Valley, Samuel B. Taft of Uxbridge.
Eastern Hampden, O. E. Bradway of Monson.
Hampshire, Franklin and Hampden, J. F. Burt of Easthampton.
Hingham, Edmund Hersey of Hingham.
Hoosac Valley, A. M. Stevens of Williamstown.
Housatonic, Charles H. Shaylor of Lee.
Marshfield, H. A. Turner of Norwell.
Massachusetts Horticultural, Wm. H. Spooner of Jamaica Plain.
Massachusetts Society for Promoting Agriculture, N. I. Bowditch of Framingham.
Nantucket, H. G. Worth of Nantucket.
Weymouth, Quincy L. Reed of South Weymouth.
Worcester East, W. A. Kilbourn of South Lancaster.

The report of the committee was accepted and adopted.

The secretary read a letter from the newly elected delegate of the Hoosac Valley Agricultural Society, Mr. Stevens, stating that he was unavoidably detained and could not be present.

Election of officers being in order, the chairman declared His Excellency JOHN L. BATES president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First-vice president, Hon. WILLIAM R. SESSIONS of Springfield.

Second vice-president, AUGUSTUS PRATT of North Middleborough.

Secretary, J. LEWIS ELLSWORTH of Worcester.*

General agent of the Dairy Bureau, PETER M. HARWOOD of Barre.

State nursery inspector, Dr. HENRY T. FERNALD of Amherst.

Election of specialists being in order, ballots were taken, and the elections resulted as follows: —

Chemist, Dr. C. A. GOESSMANN of Amherst.†

Entomologist, Prof. C. H. FERNALD of Amherst.†

Botanist and Pomologist, Prof. F. A. WAUGH of Amherst.†

Veterinarian, Prof. JAMES B. PAIGE of Amherst.†

Engineer, WM. WHEELER of Concord.

Ornithologist, EDWARD H. FORBUSH of Wareham.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, John Bursley of West Barnstable, Wm. H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, J. L. Ellsworth of Worcester, Edmund Hersey of Hingham.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, O. E. Bradway of Monson, J. Harding Allen of Barre, J. F. Burt of Easthampton.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne, Wm. A. Lane of Norton, A. M. Stevens of Williamstown.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, J. M. Danforth of Lynnfield, John

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* To take office July 1. † Massachusetts Agricultural College.

G. Avery of Spencer, Wm. R. Sessions of Springfield, W. C. Jewett of Worcester.

Committee on Dairy Bureau and agricultural products: Messrs. J. L. Ellsworth of Worcester, C. D. Richardson of West Brookfield, J. M. Danforth of Lynnfield, W. M. Wellington of Oxford, A. M. Lyman of Montague, N. I. Bowditch of Framingham.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, C. K. Brewster of Worthington, W. C. Jewett of Worcester, A. A. Smith of Colrain, Chas. H. Shaylor of Lee.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, T. H. Goodspeed of Athol, N. I. Bowditch of Framingham, S. B. Taft of Uxbridge, Edmund Hersey of Hingham.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, H. A. Turner of Norwell, J. W. Gurney of Cummington, H. G. Worth of Nantucket, J. J. Mason of Amesbury.

Committee on institutes and public meetings: Messrs. Edmund Hersey of Hingham, H. H. Goodell of Amherst, E. W. Boise of Blandford, John G. Avery of Spencer, H. S. Perham of Chelmsford.

These appointments were approved by the Board.

Mr. Jewett presented and read an essay on "Roadside improvement," which was accepted and ordered printed.

Mr. Danforth offered the following resolution, and moved its adoption: —

Resolved, That the thanks of this Board be extended to the retiring secretary, Hon. J. W. Stockwell, for his able and courteous manner of conducting the business of the office.

The resolution was unanimously adopted by a rising vote.

Mr. Q. L. Reed presented and read an essay on "The agricultural societies in Massachusetts," which was accepted and ordered printed.

Mr. Kilbourn, for the committee on agricultural societies, reported, recommending that the date for the commencement

of the fair of the Bristol County Agricultural Society be changed to the third Tuesday after the first Monday in September; that of the Eastern Hampden Agricultural Society to the fifth Friday after the first Monday in September; that of the Marshfield Agricultural and Horticultural Society to the second Wednesday preceding the first Monday in September; and that of the Weymouth Agricultural and Industrial Society to the second Thursday after the first Monday in September.

Voted, To change the dates of the several societies, as recommended.

The committee on institutes and public meetings, by Mr. Hersey, reported, recommending that the next public winter meeting be held at Athol, on invitation of the Worcester Northwest Agricultural and Mechanical Society.

The report of the committee was accepted and adopted, and the Board voted to hold its next public winter meeting at Athol.

On motion of Mr. Spooner, it was

Voted, That the Board hold a summer meeting at the Hatch Experiment Station of the Massachusetts Agricultural College at Amherst, the date to be determined by the secretary, in consultation with the executive committee and President Goodell.

Mr. Kilbourn, for the committee on agricultural societies, reported, recommending the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 29, 30, and October 1,	A. A. Smith.
Barnstable County, at Barnstable, September 1, 2 and 3,	J. G. Avery.
Blackstone Valley, at Uxbridge, September 15 and 16,	Wm. R. Sessions.
Bristol County, at Taunton, September 22, 23, 24 and 25,	O. E. Bradway.
Deerfield Valley, at Charlemont, September 17 and 18,	H. G. Worth.

Eastern Hampden, at Palmer, October 9 and 10, .	W. M. Wellington.
Essex, at Peabody, September 22, 23 and 24, .	W. H. Spooner.
Franklin County, at Greenfield, September 23 and 24, ...	J. J. Mason.
Hampshire, at Amherst, September 22 and 23, .	Augustus Pratt.
Hampshire, Franklin and Hampden, at Northampton, October 7 and 8, ...	J. S. Anderson.
Highland, at Middlefield, September 9 and 10, .	S. B. Taft.
Hillside, at Cummington, September 29 and 30, .	C. D. Richardson.
Hingham, at Hingham, September 29 and 30, .	E. W. Boise.
Hoosac Valley, at North Adams, September 7, 8 and 9, ...	J. F. Burt.
Housatonic, at Great Barrington, September 30 and October 1, ...	J. M. Danforth.
Marshfield, at Marshfield, August 26, 27 and 28, .	W. C. Jewett.
Martha's Vineyard, at West Tisbury, September 22 and 23, ...	A. M. Lyman.
Massachusetts Horticultural, at Boston, October 6 and 7, ...	F. H. Appleton.
Middlesex North, at Lowell, September 17, 18 and 19, ...	Edmund Hersey.
Middlesex South, at Framingham, September 22 and 23, ...	T. H. Goodspeed.
Nantucket, at Nantucket, August 26 and 27, . .	H. A. Turner.
Oxford, at Oxford, September 10 and 11, . .	H. S. Perham.
Plymouth County, at Bridgewater, September 16, 17 and 18, ...	J. W. Gurney.
Spencer, at Spencer, September 24 and 25, . .	Q. L. Reed.
Union, at Blandford, September 16 and 17, . .	J. H. Allen.
Weymouth, at South Weymouth, September 17, 18 and 19, ...	A. M. Stevens.
Worcester, at Worcester, September 7, 8, 9 and 10,	W. A. Lane.
Worcester East, at Clinton, September 16, 17 and 18, ...	Isaac Damon.
Worcester Northwest, at Athol, September 7 and 8,	C. H. Shaylor.
Worcester South, at Sturbridge, September 17 and 18, ...	John Bursley.
Worcester County West, at Barre, October 1 and 2,	C. K. Brewster.

The report of the committee was accepted and adopted.

The committee on institutes and public meetings, by Mr. Hersey, reported, recommending the appointment of Mr. A. M. Lyman and Mr. Charles H. Shaylor as essayists for the next annual meeting of the Board.

Voted, To accept the report, and appoint the essayists as recommended.

On motion of Secretary Stockwell, it was

Voted, That the executive committee consider the recommendation of Mr. Jewett's essay, that the societies offer premiums for roadside improvement.

On motion of Mr. Lyman, it was

Voted, That the executive committee consider the matter of recommending to the several agricultural societies to offer premiums for soil tests, in line with the work of and under the direction of the agricultural department of the Hatch Experiment Station.

Voted, That the secretary be authorized and directed to petition the Legislature to increase the appropriation for the dissemination of useful information in agriculture $500.

Voted, That all unfinished business, or new business arising before the next regular meeting of the Board, be left with the executive committee, with power to act.

The records of the second day's meeting were read and approved.

At 1.30 o'clock P.M. the meeting was dissolved.

JAMES W. STOCKWELL,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

By examination of the reports of the several inspectors, we find the societies held successful and creditable fairs, generally with favorable financial results; that is to say, they had, after paying expenses and premiums, a balance in their favor. Yet in three instances the balance was on the wrong side, and it was necessary to ask this Board to approve a mortgage; and your committee would again urge its annual caution in calling attention to the risk incurred by too large expenditure.

The Berkshire Agricultural Society and the Manufacturers' Agricultural Society in North Attleborough failed to hold a fair, and lose their representation on this Board; and the Bristol County Agricultural Society, by fulfilment of conditions, is again entitled to representation.

Respectfully submitted,

W. A. KILBOURN.
Q. L. REED.
O. E. BRADWAY.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

Your committee has held but one meeting during the year, no matters having been referred to it by the Board. The work in relation to domestic animals and sanitation was formerly in the charge of the Board of Cattle Commissioners, and naturally but little of it came to this Board or your committee. The enactment of the last Legislature, creating the Cattle Bureau of the Board, would naturally appear to consolidate and solidify the agricultural interests of the Commonwealth; but if it has had such a result, it has not come to the notice of your committee. The creation of a Bureau of a Board over which that Board has no control could but have been the conception of a master mind, so unique is it in the history of legislation. Your committee does not seek for greater power or responsibility for itself, but in justice to the Board this condition should be remedied. If a single-headed Cattle Commission is the proper system for Massachusetts, it should exist in name as well as fact. If, on the other hand, as we believe, this work should be centred under the Board of Agriculture, then the Board should be given authority to control and direct the work. Under the present condition, the Board is criticised for what it could not prevent, even if it desired to do so. This is manifestly unfair, whether the criticisms are just or otherwise, and tends to weaken the Board in its work. We would call the attention of the special committee on the revision of the laws relating to agriculture and the agricultural societies to this legislation, and to the position of your committee in regard to it.

It is our belief that the year has generally been a prosperous one with the dairy farmers of the State. The outbreak of foot and mouth disease, although annoying in the extreme to all owners of live stock, in that it prevented the making of additions to herds and closed the natural cattle markets of New England, has not assumed as serious proportions as were at first feared. Your committee sympathizes with the owners of infected herds in the monetary loss and the annoyance to which they have been subjected, and would recommend that this Board use every effort to secure the passage through the Legislature of the necessary legislation to reimburse to these cattle owners the thirty per cent of the value of their animals which the United States government deemed inexpedient to give them; also, legislation to secure for them compensation for any hay, grain, buildings or other property which it may be found necessary to destroy for the purpose of completely stamping out the disease.

Respectfully submitted,

ISAAC DAMON.
JOSHUA CLARK.
JOHN S. ANDERSON.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

The station work is continued as usual, as reports of the various department heads will show. All this work is intended to benefit the practical farmer and gardener, but it is doubtful if under present conditions this aim is reached.

Perhaps the publications of the station are not as widely distributed as is desirable, and if this Board could hold a summer or autumn field meeting at the station, with personal explanations of experiments by the professors, many valuable suggestions might be disseminated through the members to others who are unable to avail themselves of the same opportunity.

Within a few years the botanical department has made experiments in the so-called "soil sterilization," and very successfully; so much so that many large market gardeners have adopted the plan, and are conducting their business with much greater profit.

I am frequently met by inquiries as to how certain insect pests can be exterminated from gardens, and the safest reply is: "Send a specimen to the Experiment Station at Amherst." They are always on the lookout for such enemies there, and the beauty of their shrubbery, their fruit trees and their finely kept grounds attest how well the battle is fought.

Respectfully submitted,

WILLIAM H. SPOONER,
Chairman.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

In behalf of the committee on forestry, roads and roadside improvements this report is presented.

Forestry. — The present scarcity of coal has increased the demand for wood as fuel, and appears to have raised the price asked for both cord and standing wood, and of the land upon which such is grown. It has developed a recklessness in the treatment of wood lands, that will be more evident to future generations than to the present owners or occupants. The injury from insects is felt in the forests, sprout land, shade and other trees of this State, to the injury of all. The value to the economies of the State of an understanding of the rules of forestry in their most advanced form should be kept before our citizens.

The forestry schools, at Cornell University, Yale University, Biltmore and elsewhere, are doing much to enlighten our people, and produce educated leaders in the interest of our nation's increasing forestry needs.

Roads. — The importance of good roads cannot be overestimated. A good road is the means of increasing the power requisite to haul teams, but a bad spot in a long stretch of roadway is like a weak link in a chain. But we cannot expect completeness on these, or other lines, too quickly. This subject is placed in charge of the Highway Commission, who have the improvement of the Commonwealth's roads in their care.

Roadside Improvements. — It is gratifying to notice that His Excellency Governor Bates has referred to the importance of this subject in his inaugural address, in connec-

tion with the work of the Highway Commission, who by their appropriations and organization can best and most effectively bring about good results, and good object lessons, on these lines.

The great danger to our profit-yielding, shade-giving, and scenery-making, leaf-bearing trees from insect pests and fungous growth is too well known, and requires the best thought that our Commonwealth can give to the subject. The Massachusetts Society for Promoting Agriculture has recently offered to the cities and towns of the State to provide a lecturer and stereopticon to the extent of fifty lectures on this subject during January, February and March, and a considerable number have already been assigned. The fact that Mr. A. H. Kirkland is the chosen lecturer guarantees an intelligent presentation of this subject.

By unanimous vote of the committee,

FRANCIS H. APPLETON,
Chairman.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[Revised Laws, chapter 89, section 10, adopted by the Board, Jan. 13, 1903.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

Your committee first visited the college on June 14, when the "Grinnell prizes" were awarded as follows: the first to Joshua H. Belden of Newington, Conn., and the second to Edward B. Saunders of Southwick, Mass.

Your committee regard the farm connected with the Agricultural College as an important part of the essentials of the institution, and in all departments connected therewith the aim should be to so conduct it that an object lesson should be ever before the public, as well as the students who are giving their time at least to the acquiring of a systematic agricultural education. A young man must be an admirer of what he sees as well as what he does, in order to derive the best results, and to this end the class in agriculture should have continually before it the best specimens produced. We cannot grow good crops from inferior seed, neither can good stock be produced from "scrub sires and dams." "Like begets like." We are glad to notice that all the farm crops except corn have been grown to a profit, the balance being on the right side, the statement showing a net profit of $1,634.04, and a loss of $58.07 on 40 acres of corn.

Your committee are pleased with the systematic care taken with everything connected with the farm, but we believe there should be a better class of stock. There are a few

good specimens, but many that would be considered unfit to remain long in the barns of our most unpretentious farmers. We should urge the importance of weeding out many of the sheep and cattle and replacing them with the very best specimens, that the State should be above criticism in the management of any of the departments of its public institutions.

The horticultural department this year has been changed in the head of the department, and the work has been hampered somewhat by the reorganization incidental to that change, and has been largely one of preparation of the work to be carried on by the new instructor. A number of changes have been made in certain lines, particularly in the courses of instruction. Several new subjects have been added, and the work of landscape gardening has been enlarged. The advanced work of seniors who elect horticulture has been reorganized, and the number of students taking the work in this department is larger than in previous years. The work in other departments has been carried on upon similar lines to that of the past few years, with increased interest shown in all.

We report with pleasure that the freshman and junior classes are larger than for many years, and, with the ample accommodations in the buildings now being erected, we trust that each year will show an increased attendance; and we would earnestly urge our people to give the support to this institution that it merits, not only by liberal appropriations from our State treasury, but by encouraging our young men to avail themselves of its advantages, that they may be better fitted to grapple with problems that are ever arising, and need educated minds as well as hands to master them. In short, may this practical course seem as necessary to our young men as did the district school to our grandfathers.

Respectfully submitted,

JOHN BURSLEY.
C. K. BREWSTER.
A. A. SMITH.
W. C. JEWETT.

REPORT OF COMMITTEE ON INSTITUTES AND PUBLIC MEETINGS.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

Your committee take pleasure in reporting the educational features of the Board of Agriculture, as they look upon them, in a very satisfactory condition.

The addresses at the summer meeting during the fiftieth anniversary of the organization of the Board, held at Boston, and the lectures at the winter meeting, held at North Adams, did great credit to our honorable Board, and by the regular system of publication and dissemination become a worthy addition to the farmer's library, known as the "Agriculture of Massachusetts."

The institute meetings, held as they are in nearly every section of the State, we believe are bringing to the farmers' very homes the educational assistance in their calling which was intended by the early actions of this Board. While the institute work of the Board is very successful and the return for the cost to the State as high as could reasonably be expected, the question is forced home on your committee as to whether the time is not close at hand when this Board should ask for a larger appropriation, and attempt to systematize the work further; whether better results could be obtained by the appointment or election of an agent of this Board, at a proper salary and with a reasonable appropriation to work with, to exercise a closer supervision over the institute work, giving his entire time to the supervision of the arrangements for the meetings and their actual conduct, — is a question which your committee would earnestly commend to the consideration of the special committee on the revision of the laws relating to agriculture.

Your committee has held two meetings for the consideration and preparation of the list of speakers for the year, and has given the matter careful consideration, endeavoring to cut out all dead wood from the list, and to eliminate any subjects not strictly in the line of agriculture. We believe the result is a better and more consistent list of speakers and subjects than has heretofore been put forth.

We would call attention to the weak spots in the work, as well as the strong ones. We believe that the small attendance at the meetings of a few of these societies should be corrected, for their own good and the good of the Board. Your committee, the secretary of the Board and his office force have used every effort to bring about improvement, and it is but just to them to say that an improvement is to be noted during the past year.

During the year 1902, 120 farmers' institutes were held under the direction and control of this Board. All of the societies represented on the Board, with the exception of the Massachusetts Society for Promoting Agriculture, held the 3 institutes required. There have also been institutes held in sections of the State where there are no agricultural societies having membership on this Board, and where there seemed an imperative call for such meetings.

The average attendance of the institutes has been very good, being 104, against 107 last year, 91 in 1900 and 94 in 1899. At 3 of the institutes the attendance was 300 or over; at 12, from 200 to 300; at 37, from 100 to 200; at 39, from 50 to 100; and at 25, less than 50. There are a few societies which still need to improve their work in this line, in spite of the constant efforts of this office.

The attendance at each institute held by the several societies in 1902 was as follows: —

Amesbury and Salisbury, 85, 41, 75.
Barnstable County, 140, 55, 155.
Blackstone Valley, 75, 25, 50, 125.
Bristol County, 225, 200, 200.
Deerfield Valley, 65, 75, 100, 150.
Eastern Hampden, 100, 12, 50.
Essex, 72, 80, 75.
Franklin County, 16, 45, 35.
Hampshire, 250, 40, 30.
Hampshire, Franklin and Hampden, 105, 150, 125.
Highland, 100, 100, 50.
Hingham, 20, 100, 392, 74, 137.
Hillside, 70, 50, 150.
Hoosac Valley, 25, 20, 30.
Housatonic, 150, 20, 45.

Manufacturers', 200, 300, 175.
Marshfield, 72, 62, 35.
Martha's Vineyard, 43, 16, 21.
Massachusetts Horticultural, 30, 50, 75, 80, 100, 40, 60, 150, 50
Middlesex North, 150, 200, 200, 125.
Middlesex South, 200, 150, 100.
Nantucket, 15, 60, 75.
Oxford, 75, 175, 100.
Plymouth County, 65, 60, 65, 40.
Spencer, 75, 65, 100.
Union, 155, 160, 250.
Weymouth, 50, 40, 35.
Worcester.*
Worcester East, 150, 75, 80.
Worcester Northwest, 83, 185, 120, 253.
Worcester South, 25, 63, 70.
Worcester County West, 125, 125, 75.

Respectfully submitted,

F. W. SARGENT.
EDMUND HERSEY.
WESLEY B. BARTON.
H. C. COMINS.

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* Attendance not given.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.*

[Read and adopted at the Annual Meeting, Jan. 13, 1903.]

Your committee on gypsy moth, insects and birds submits herewith its report for the year 1902.

It may be well to state at the outset that since Feb. 1, 1900, no legislative appropriation has been available for work against the gypsy moth. Your committee therefore has not been required to carry on an active campaign against this insect; instead, its activities have been along the lines of recording the increase and spread of the moth and of advising property owners how best to combat it. As a consequence, this report deals with the depredations of the moth during the past season and its present known distribution.

Your committee has made inspections of the infested territory before the eggs hatched in the spring, again when the caterpillar plague was at its height, and still later after the eggs had been deposited in the fall. From these investigations, as well as from voluntary reports of reliable observers, it has been possible to follow with a considerable degree of accuracy the development of all the older and more important moth colonies.† We have endeavored to give a faithful yet conservative statement of the present situation as regards the moth, — a situation which even in its best aspects is sufficiently alarming.

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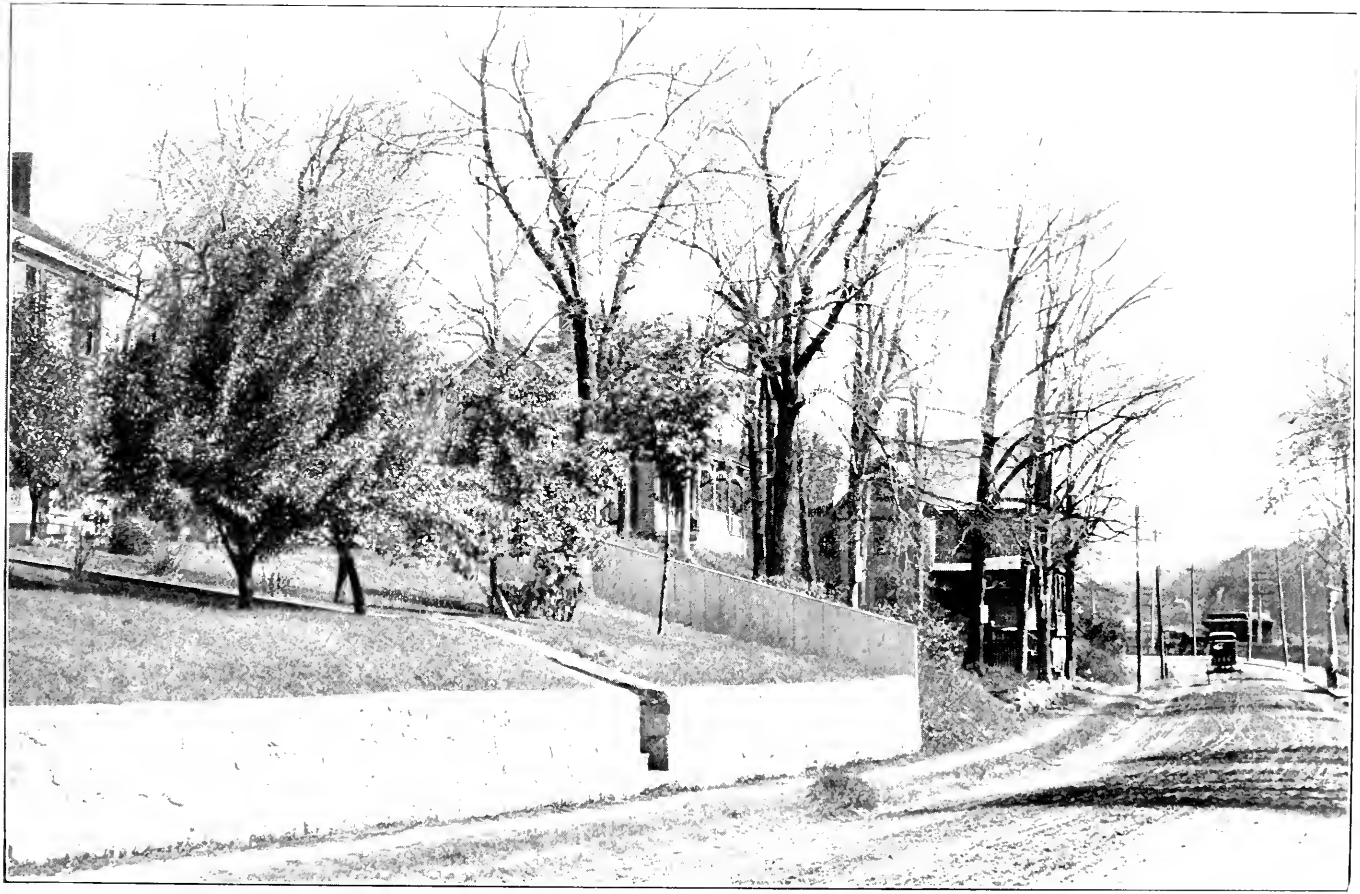
* House Document, No. 259, 1903.

† For information concerning the spread of the moth we are especially indebted to H. L. Frost, Arlington; C. E. Merrill, Melrose; C. E. Mann and W. G. A. Turner, Malden; and A. H. Kirkland, Reading.

Work of the Gypsy Moth the Past Summer.

In the spring of 1902 the egg clusters of the moth were present in large numbers in many sections of Arlington, Medford, Malden, Melrose, Saugus and elsewhere, and as soon as the foliage developed, swarms of tiny gypsy moth caterpillars attacked it. At first the damage was little noticed, but as the weeks passed and the caterpillars approached maturity it became only too apparent. Local outbreaks nearly as severe as any of the earlier years of 1888–90 occurred in nearly all the worst infested towns. From the rocky hilltops to the north of Boston one could easily detect many brown, stripped areas, contrasting sharply with the normal green of the woodland. Feeding for a few weeks in the colonies where they were hatched, the caterpillars soon exhausted the foliage supply, and then began that characteristic migrating in swarms which renders them such an annoying as well as dangerous pest. From the edge of stripped woodlands the insects swept like a devouring swarm over fruit and shade trees, over garden crops and flowers, and even devoured the grass in every line of march.

The experiences related by suffering householders as well as the scenes to which this committee was an eye witness simply beggar description. At Lynnfield a strip of woodland half a mile long and from ten to twenty rods in width was completely defoliated and left as bare and brown as if seared by fire. Near the poor farm at Melrose some ten acres of second-growth oak were absolutely stripped of foliage; the trees are never more destitute of leaves in midwinter than they were there in the middle of July. In the rear of the Oak Grove station at Malden a plot of old oak growth, containing perhaps half an acre, was stripped; and from the trees overhanging the street the caterpillars dropped in such numbers that passers-by were obliged to raise umbrellas to protect their persons. Over the doors and in the cornices of the station the caterpillars literally hung in festoons. At Baker's Hill, Malden, the swarming insects massed on house walls obscured the color of the paint and made all a uniform dark brown.



Trees stripped by the Gypsy Moth at Oak Grove Station, Malden, July, 1902.

Serious outbreaks also occurred at Arlington, Belmont and Watertown, and to a smaller degree at Lexington, Woburn and Lynn. During a day's drive through the infested territory early in July the committee saw all told at least one hundred acres of woodland practically defoliated by the moth. By the last of June so formidable had become the caterpillar plague and so unendurable the nuisance that the mayors of four cities in the northern metropolitan district consulted with the Governor and Legislature near the close of the last session, asking for legislative relief. Their request for aid by special legislation made at such a late date was not granted. At Malden and Melrose municipal funds were drawn on to pay ten cents per quart for the caterpillars at the time of greatest damage. The insects were gathered by hand, mainly by children, and carried in all kinds of receptacles. While almost incredible numbers of the larvæ were destroyed in this way, there is no doubt that this careless method of collecting the insects has resulted in their increased distribution; as a matter of fact, only a small reduction in the number of egg masses, even in the largest colonies, was accomplished by this method.

Present Condition of the Infested Territory.

The present condition of the infested territory is indeed serious. From Waltham to the sea there are now a large number of well-established woodland colonies, which wait but for a favorable season to greatly extend their area. In such colonies the egg clusters may be found by the thousand, and here next season there will be outbreaks as bad, if not worse, than those of 1902. These strong colonies are not only a menace to the woodlands where they occur, but serve also as plague spots from which a large area of surrounding farm or residential territory may become infested. Thus if they are neglected they easily spread farther and farther into non-infested territory. We believe these colonies are entitled to special mention, since in our judgment they constitute the most important feature of the infested territory. As long as the woodlands are infested the moth will abound throughout the entire district.

The moth is quite generally scattered throughout the Fells reservation of the metropolitan park system. The worst infestations, being known, have been watched and treated under the direction of the Park Commission. It is apparent, however, that the insect is increasing in these woodlands, and more work will be needed in the future than in the past to suppress it.

The colonies in the residential districts have developed faster than those of the woodlands, but from restricted food supply and greater ease of treatment are not as large or as difficult to control as those of the wooded sections. Their rapid development as compared with the woodland colonies may be due to the more heroic and extra thorough treatment formerly given these latter colonies by the employees of the committee. There is also little doubt that the greater abundance of native insectivorous birds in the wooded sections has resulted in checking to some extent the increase of the moth, while the latter has been directly favored by the English sparrow in residential sections. The colonies in the residential districts are of a very annoying nature. The caterpillars strip orchard and shade trees, thereby destroying fruit and foliage; where abundant, they invade houses; when the food supply is exhausted, they march, often by night, in search of foliage. It thus results that one may retire the owner of trees in full foliage or garden crops in thrifty growth, and wake to find only bare twigs or riddled leaves where the caterpillar swarm has passed. Again, the residential colonies are the means of spreading the moths to an important degree. The young caterpillars spin down from the trees and drop on passing teams. In sections where the wagons of the milkman, grocer or butcher are continually on the road, a general infestation by the moth is bound to result.

At Watertown there is at least one large and important colony in the residential district. In Cambridge and Somerville there are several small colonies. Belmont has one large woodland colony, embracing nearly a square mile. Arlington is generally infested. Along both sides of the "upper mill pond" the willows are thoroughly infested.

There is an important colony in the north-western part of the town, near the Belmont line. Lexington has a few small colonies and one of considerable size near the Woburn line. Winchester shows scattered infestations, with at least one large woodland colony in the southern part. Medford, Malden and Melrose are thoroughly infested, both in woodland and residential sections. The moth is present in large numbers in each of these cities, and here next season, if unmolested, will cause widespread damage. Everett and Chelsea have a fair quota of residential colonies. Saugus, Lynn and Lynnfield have important woodland colonies. The outlying sections — Newton, Lincoln, Georgetown and the north shore — are still in comparatively good condition.

Now that it is well known that relief from the gypsy moth is necessary, it will not be amiss to review briefly the history of the State work against the pest. The first notable ravages of the moth took place in 1888–90. In Arlington, Medford, Malden, Everett and vicinity, fruit trees, shade trees and even garden crops were ravaged to such an extent, and the caterpillars became such a nuisance, that the municipal authorities of eight cities and towns united in petitioning the Legislature of 1890 for State help in suppressing the moth. The people had combated the swarming insects as best they could, had been defeated at every turn, and as a last resort invoked the aid of the Commonwealth to save their trees from destruction.

The State work, at first carried on by two successive commissions, was placed in charge of the Board of Agriculture in April, 1891. From 1890 to 1899 inclusive the several Legislatures appropriated various sums, aggregating about a million and a quarter of dollars, "to prevent the spreading and secure the extermination" of this foreign insect pest. It was a novel undertaking, — a step into an unknown field. There was no precedent for a guide. Methods had to be devised and perfected. The territory had to be scouted and the infested areas located. Men had to be selected, trained and organized, so that the greatest possible results might be obtained. Legislative appropriations were ample in certain years, in others much reduced below the needs of the work.

Sometimes they were made available when needed, at others granted after long and expensive delays and consequent loss of working time. In spite of all these difficulties, the work went steadily forward toward the desired end, until in January, 1900, this committee was able to report: "From the results of the past two years it is evident that the work against the gypsy moth in Massachusetts is already approaching its final stages. The large colonies have been practically wiped out; many of the smaller colonies have been exterminated or are thoroughly under control, and need but two or three seasons' work to secure their absolute extermination. Three years ago there were many localities in the infested district where there were large masses of egg clusters. To-day the infestation of the region consists of the scattered remains of former colonies and their offshoots, which must be subjected to careful and continual examination and treatment for a series of years."

The work of the committee was made the subject of a protracted investigation on the part of a special legislative committee in the early months of 1900, and after several examinations of the infested district they too reported: "There are to-day, so far as known, no large colonies."

It has been fully demonstrated that this statement was a fair and temperate representation of the facts of the case. The gypsy moth committee was not mistaken or misinformed. The expert entomologists who had investigated and commended the work had not been misled. The testimony of hundreds of grateful citizens whose property had been freed from the pest was correct. *The moth was under control.* That no alarming outbreaks occurred in 1900 showed most convincingly that there were no important colonies in existence at that time. But the increase of the moth waits not on the bidding of man. It knows no law but the law of nature. The few scattering egg clusters remaining in the spring of 1900 had increased to formidable numbers in the fall of 1901, and the presence and probable danger from the latter were duly reported by this committee: "From the general and increasing infestation of the entire district, we are led to fear that soon, unless preventive

action is taken, the scenes of the historic outbreak of 1888–90 will be repeated, on an even larger scale."

This prediction unfortunately has been fulfilled. It is not necessary to describe further the caterpillar outbreak of 1902. From some ten years' experience with this pest we believe that, bad as have been the recent depredations, the future has even worse and more widespread damage in store. The year just passed has proved anew the futility of individual efforts in controlling the moth, and the pressing need for thorough-going, concerted, systematic work against the pest over the whole infested district.

AUGUSTUS PRATT.
JOHN M. DANFORTH.
FRED W. SARGENT.
JOHN G. AVERY.
WM. R. SESSIONS.
JAMES W. STOCKWELL.

REPORT OF THE LIBRARIAN.

[Read and accepted at the Annual Meeting, Jan. 13, 1903.]

To the Secretary of the Board of Agriculture

SIR: — The sixth report of the librarian is herewith presented.

The expenses incurred in 1902 on account of the library were less than usual, being but $79.26. Of this amount, $43.80 was spent for current publications for the library and for office use, $21.18 for books and $14.28 for supplies.

One hundred and sixteen volumes were added to the library in 1902, making the present number of volumes 3,567.

The loaning of books to responsible parties has been continued, and a larger number of persons than usual, 33, availed themselves of the privilege, and took out 80 books. The increase in number of persons taking books was 10, and the increase in number of books taken was 34. As usual, the books taken covered quite a range of subject-matter, the sections predominating being agriculture, including crops and manures, with 15: insects, 15; forestry, 9; flowers, fruits and poultry, 6 each.

The labor of compiling data for the history and work of the State Board of Agriculture, referred to in the last report of the librarian, has been advanced towards completion, and the material collected is submitted as a part of the librarian's report for 1902.

Respectfully,

F. H. FOWLER,
Librarian.

THE AGRICULTURAL SOCIETIES OF MASSACHUSETTS.

BY QUINCY L. REED OF SOUTH WEYMOUTH.

In the early part of the nineteenth century, less than fifty years after the close of the revolutionary war, agricultural societies were first organized in many of the counties of Massachusetts. Among them were the Massachusetts Society for Promoting Agriculture, in 1792; the Berkshire Society, in 1811; the Hampshire, in 1814; the Essex, in 1818; the Hampshire, Franklin and Hampden, in 1818; the Plymouth County, in 1819; and the Bristol County, in 1823. The bounty now received from the State was granted to these societies in 1818.

These societies were purely agricultural, and under careful and economical management were enabled to acquire and accumulate a fund, — some of them quite a large fund. They were also more of a social character, and the citizens of the different towns throughout each county usually devoted one day at least to attend these fairs, to meet and greet their friends, relatives and acquaintances. These conditions continued for a period of twenty-five to forty years, or until about 1850. During that period there were only a very few new societies organized. After 1850, for a period of more than a quarter of a century, agricultural societies increased rapidly throughout the State, conditions changed decidedly, grounds were purchased by many of the societies, tracks were laid out, trotting races added, also different kinds of amusements or attractions.

It was during this period, 1864, that my own society, the Weymouth, was organized, which continued for a quarter of a century outside of the State Board. The Brockton Society, still outside of this Board, was organized in 1872,

and was very soon in the front rank among agricultural societies, on account of its success. It was about this time that offices were established in certain localities for the purpose of furnishing amusements for agricultural societies, and parties were brought from different parts of the country for that purpose. Competition arose in this department, prices advanced, and the success of some of the societies was such that large prices were offered these parties.

About this time parties interested in the horse department began to make regular circuits during these fairs, and the cry was, that if these societies wished to prosper and succeed they must increase their appropriations for horse trotting, have better horses, more attractions to increase the attendance. The Weymouth Society, then outside the State Board, increased its purses for horse trotting, also added more attractions, and the result was, these two departments absorbed the whole receipts. The society soon found itself nearly $6,000 in debt, with nothing to pay its premiums, which were the first to suffer from the increase in the expenses in these two departments.

Not long since I received a marked paper, with an article headed "Bets at fairs," making a general accusation, unfavorable to the agricultural societies of the State, in regard to horse trotting and pool selling, saying, "The situation seems to have reached a point where the people of common decency in the towns ought to bestir themselves." I know not who wrote this article, but if the individual knew of any society or societies that were guilty of this offence, and was interested in the welfare of these societies, what was his duty in this matter? The statutes provide a remedy in these cases. Follow the statutes; let us know where the trouble is; show up societies that are guilty of this offence, that is so objectionable to common decency, as they should be shown up. If the individual did not know of any society or societies guilty of these illegal measures, and has made these sweeping allegations, published in a journal of reputation, circulated broadcast over the country, it indicates a maliciousness such as I have not witnessed since becoming a member of this Board, including, among the rest, my own

society, where trotting of the kind has never been known to occur since its organization, and, as I have said before, we were twenty-five years outside of the State Board.

It is a well-known fact that no trotting association can sustain itself without pool selling or something of the kind. Does any member of this Board suppose there has been no pool selling in this State during the last season? Then why are all these agricultural societies throughout the State made such a prominent target just at this time? I have never as yet been able to learn of any of the societies in the State represented on this Board that has allowed pool selling. Such an article was uncalled for, and I cannot regard it in any other light than a direct insult to the officers and citizens connected with these institutions, and more especially to this Board of Agriculture. The inference would be that the officers of these institutions were not aware of the liability they incur, or did not care.

Among the different societies of the State, seven are purely agricultural or horticultural; four appropriate less than $100 each for trotting purposes, averaging about $40 or $50; five appropriate between $100 and $500 each, — an average of about $340. Here we have one-half of the societies of the State purely agricultural, and purses so small they would not attract horse racing, much less pool selling. Ten of these societies appropriate an amount between $500 and $1,000 each, —an average of about $740. Among them is my own society, which is no nearer perfect than the others. Five of them appropriate between $1,000 and $3,600 each for horse trotting alone. Among these societies paying the largest amount for horse trotting is the Bristol County, which pays the largest amount of any society in the State.

To illustrate the possible injury one society may do another, even unwittingly, reference is made to the interference of dates for the holding of the fairs of the Bristol County and Weymouth societies, which came before this Board for action some two years ago. At that time some of the members of the Board even could not see how a conflict of dates could affect the Weymouth Society, twenty

miles away. It is not in the agricultural department the injury comes. If we must have this trotting, we want it to pay. I will only ask you one question in connection with this matter, — a question of facts. If the Weymouth Society appropriates $600 or $700 for horse trotting at its annual fair, and the Bristol County Society appropriates $3,600, and both societies hold their fair the same week, how many entries do you suppose the Weymouth Society would be likely to get?

The Bristol County Society is ten miles south of Brockton, and the Weymouth Society is ten miles north of Brockton. All the conditions in connection with Brockton are applicable to each of them alike. It would be futile for the Weymouth Society to compete with Brockton. The first two days of the Brockton fair last fall the weather was unfavorable. At that time the citizens of the place took hold and did what no other city or town in the country would have done. Every individual was interested in the success of that society. It is not so in Taunton or Weymouth.

The society paying out the next largest amount for trotting purposes is the Worcester Society, $2,776, and this society has a fund comparing with Brockton, is centrally located and surrounded by agricultural societies, and of course it can carry out anything it wishes. Is it just and right, in the interest of the State and in the interest of the surrounding societies, that this society or any of these societies should pay such an amount for trotting alone?

Among the other societies that pay these large amounts are the Franklin County, $1,200; the Hoosac Valley, $1,500; the Housatonic, $1,600; and the Worcester Northwest, $1,650. The Hoosac Valley Society increased the amount from $1,000 to $1,500 a year ago, which is rather a bad omen, while the Housatonic Society reduced its amount a year ago from $1,800 to $1,600. These amounts are large, comparatively, in proportion to the receipts of these societies. No society in the State, and I will not except a single one, can open an account in the different departments connected with these agricultural societies and show that

this trotting department pays. The day is past when this department will attract very largely, outside of those interested in winning the purses. If the entrance money was sufficient to pay these purses, I would not say one word against it, as in some societies it is, or nearly so. It would place these societies on a paying basis. They would soon be in a prosperous and thrifty condition, with means that could be applied to the advancement of the agricultural interest. If, on the contrary, it is drawing the money from the departments that do pay, it is sapping these societies. These amounts appropriated by all these societies a year ago aggregated $21,576 for trotting alone. If we add to that the attendant expenses which follow in the wake of these trotting races, and also other attractions, it amounts to a much larger sum. If we deduct the seven societies that are purely agricultural and the four that pay less than $100 each for trotting, it leaves twenty-one societies paying out on an average of $1,000 each for trotting alone, — a regular harvest for those interested in trotting, being under no expense, only to enter their horses, win the money, and the agricultural societies pay it. The only instance I have ever known where the entrance money equalled the amount paid in purses was in the Weymouth Society one year, and we were successful that year.

If these societies could be restricted to paying out only a certain percentage of their gate receipts yearly for horse trotting, it would place them in a more equitable position throughout the State. They would soon be on a paying basis, with means that could be applied to the advancement of the agricultural interest. If such a method was undertaken, legal complications might arise which would be objectionable; but these societies can never place themselves in the position they should occupy in their relations with the State as long as they continue the present methods.

Now, I have not read this essay with any idea or spirit of censure. It is an impossibility, with any degree of justice, to censure any society in this matter or any individual connected with them. It is something that has

grown through changed conditions, competition, and a desire to build up these societies, and these existing conditions were unavoidable. This whole matter can be summed up in very few words. If the receipts in this trotting department are sufficient to pay the purses, it is all right; but if they are not, the agricultural interest pays the bills, and it is all wrong.

ROADSIDE IMPROVEMENT.

BY WARREN C. JEWETT OF WORCESTER.

The matter of roadside improvement has not received the attention from our rural population that it deserves, and I know of few subjects upon which so little has been written as upon this. It is certainly worthy the consideration of every property owner in Massachusetts, for there is nothing that would add more to the attractiveness of our State and to the value of our farms than improved roadsides.

All thought and study regarding road making in this country for years has turned to grades, drainage and road beds, and almost no attention has been paid to roadside adornment. But the beauty that may be added to any road or street at the cost of little trouble or expense is a direct source of refining influences to all that portion of the public using them. The great variety of trees, shrubs, bushes, hedges and flowers that are possible along a roadside would be a comfort to the traveller and a delight to the eye.

With our State roads, which will soon extend throughout the length and breadth of our Commonwealth, and upon which the State has spent millions of dollars already, we should begin at once to improve our roadsides, that they may be not only attractive to the travelling public, but also a source of pleasure and satisfaction to owners of adjoining property.

It is acknowledged that Massachusetts has the best roads of any State, and this fact is doing much to advertise our farm property. Other States are feeling the effects of our State roads. The "Nashua Telegram" says that, "if the Granite State is to hold the prestige of the past and still remain the Mecca for visitors and tourists, the State must

see to it that the roads are put in the best condition possible. The people of other States are building systems of modern roads which form a very attractive feature, and one that will do much to attract outsiders. New Hampshire must do the same, and the need of a grand State road up the Merrimack valley to the mountains is a good illustration of this phase of the question."

Every year more and more of our people are shaking off city modes of life and are moving outside within easy reach of their business, and where they can enjoy a home surrounded by the beauties of nature. With our electric roads reaching into almost every town in our State, this class is bound to increase, and many of its representatives are people of wealth; consequently, we should look for a great improvement in our roadsides within a few years.

I believe, as we study this question and read the laws governing our roadsides and the duty and powers of the tree warden and the forester, we shall find many drawbacks to what is known as up-to-date roadside improvement. Under the law the only thing of value that is recognized is a tree, and that is held sacred; and the owner, or rather the abutter, cannot cut one on his own roadside without a public hearing. I believe there should be laws governing this matter; but have we not gone too far for the best interests of roadside improvement? There are many who advocate that there should be changes in the tree warden law, even to the giving of the tree warden more power than he now has. Let us go slow in this matter, that we may not hinder the best thought and attention in roadside improvements.

Surely it is not true progress to lay out every suburban highway on the same metropolitan model, — that is, we should not be compelled to conform ourselves to a row of trees on each side of the road: in doing this we should lose the individuality, the thought and the enthusiasm that many might work out in roadside improvement. There is nothing that attracts us more than the individuality of a man's character, his business or his home; and will we not enjoy the same in his roadside improvements? Any law that deprives him of the right to work out his own ideas in the beautify-

ing of his own property will tend to discourage him in that work. Village improvement societies have done much to improve our roadsides; but in some villages there seems to be a tendency to reduce everything to the condition of the city, thus marring natural beauty and destroying many attractive features.

When we contemplate improving a roadside, there are two very important things to consider: first, what improvements shall we make; and, second, what shall we plant. In the first place, if the roadsides are near our buildings or against open fields, let us clear them up and plow and seed to grass as far as possible, that they may be a source of profit as well as a pleasure to look upon. The question as to what we shall plant, while depending largely upon locality and surroundings, becomes also a matter of personality. Depend on your own taste, study to find out what will best suit your locality, what your requisites are, and then so far as possible go into the woods and find your material.

If you enjoy trees, and the road to be improved is near your buildings, perhaps there is no better way than to set out some of our beautiful shade trees that are best adapted to your locality. There is nothing that the weary traveller or the tired horse enjoys more in the hot summer time than to come under the shade of the grand old elms and maples that are found scattered all over New England. For this reason, it might be well for every farmer to set some portion of his roadside to trees, for the benefit of the coming generations. But remember that, whatever trees you set out, they must have care; for, with the elm-tree beetle, the gypsy moth and other tree pests, the telephone lines and the electric cars, a continual fight in the future must be waged, if you wish to save the life of the trees and enjoy the comfort that they should bring you.

That portion of our roadsides running through the farms of Massachusetts against our cultivated fields I believe should be free from trees to a large extent, because there is no question to a practical farmer that they sap the ground of the moisture and fertility that are needed by the crop, whatever that crop is, thereby making a serious decrease in

the profit upon hundreds of acres in this State. Would it not be far better to place our roadsides in a condition to grow grass, and take the same care of them we do of our fields, thereby not only increasing the income, but the attractiveness of our homes as well?

If you wish to go still farther in beautifying these roadsides and in making them more attractive, then plant by the walls some of the following vines, — the small flowering clematis, the Japanese trailing or memorial roses or the crimson and other varieties of ramblers, — and you will have one of the most beautiful roadsides that can be found in this country. Along our roadsides through the woods, especially when the soil is moist, I believe the trees should be cut the entire width of the road, so as to admit the sunlight and the air, thereby making a better road, free from mud the greater part of the year. This will make a great saving in the care and maintenance of said road, and will also benefit the health and the disposition of the travelling public.

Our State Highway Commission has followed this idea in almost every road it has laid out. The wood is cut and the rubbish removed, also loose stones and everything that does not attract the eye, but leaving the large boulders and those forms of nature that so many enjoy, and retaining the native shrubs that are being used more and more in the best park roads of our State. In many places, where the conditions are adapted to it, what would be more attractive than a solid border of ferns? There are places that would be improved by the planting of climbing vines and creepers. Were we to remove all of this class of plants from the forests and waste places, there would be a stiffness and barrenness where beauty might prevail. We should also lose much of the verdure of the summer and the rich coloring of the autumn foliage.

This suggests that there are places which would be improved in appearance by the judicious planting of some of the most desirable of the many climbing plants. Probably the most unsightly places are where the sloping banks are left uncared for at the sides of our streets and roadways. The wasting of these banks can be prevented by planting

thickly on their sides such climbing plants as the Virginia creeper, honeysuckles of strong-growing varieties, trumpet vine, the small flowering clematis and the woodbine. Most of the plants mentioned are also suitable for covering barren or rocky places. Unsightly mounds, old stumps and tree trunks can be made beautiful by very little care and at slight cost, and may become among the pleasing features of a roadside. A striking feature may be added to road adornment by sowing the seeds of wild flowers where grass does not readily take root, as along sandy waysides, where very satisfactory results may be obtained by sowing lupine seeds.

With the improvement of the roadsides would naturally come the removal of the great advertising signs which disfigure so many streets and public places. Massachusetts has taken the lead in road building: and let us, as the State Board of Agriculture, take the lead in roadside improvements. Let this Board recommend that some part of the bounty received from the State by the several agricultural societies be offered as a premium for the best roadside improvement. If this was taken up, as I believe it should be by every society in the State, what a great change it would make in the roadsides of our State.

FIRST ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JAN. 13, 1903.

FIRST ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to present herewith the first annual report of the State Nursery Inspector.

The knowledge that much of the nursery stock sold in Massachusetts is infested by injurious insect pests and fungous diseases has for several years led to a desire on the part of fruit growers and others interested to obtain some degree of protection from such foes. During the winter of 1901–1902 this desire resulted in the presentation to the Legislature of a bill requiring the inspection of all nursery stock grown in the State, and making certain requirements for all brought in from elsewhere. The text of the law enacted as the result of the presentation of this bill is as follows: —

[ACTS OF 1902, CHAPTER 495.]

AN ACT TO AUTHORIZE THE STATE BOARD OF AGRICULTURE TO APPOINT A STATE NURSERY INSPECTOR, AND TO PROVIDE FOR THE PROTECTION OF TREES AND SHRUBS FROM INJURIOUS INSECTS AND DISEASES.

Be it enacted, etc., as follows:

SECTION 1. The state board of agriculture shall annually appoint some person qualified by scientific training and practical experience, to be state nursery inspector, and he shall be responsible to the board for the performance of his duties as prescribed in this act. The said inspector may appoint such number of deputies, not exceeding three, as he may deem necessary or expedient.

SECTION 2. It shall be the duty of the state nursery inspector, either personally or through his deputies, to inspect at least once each year all nurseries or places in the state where nursery stock is grown, sold or offered for sale, and if no dangerous insect or fungous pests are found therein a certificate to that effect shall be given. If such pests are found therein the owner of the stock

shall take such measures to suppress the same as the state nursery inspector shall prescribe, and no certificate shall be given until the said inspector has satisfied himself by subsequent inspections that all such pests have been suppressed.

SECTION 3. Any owners of nurseries or of places in the state where nursery stock is grown, sold or offered for sale, who do not hold an unexpired certificate of inspection after the first annual inspection made after the passage of this act, who shall sell or otherwise dispose of nursery stock in the state, shall be subject to a penalty of not less than twenty-five nor more than one hundred dollars for each offence.

SECTION 4. Any owners of nurseries or of places in the state where nursery stock is grown, sold or offered for sale, who shall fumigate with hydrocyanic acid gas all stock which they sell, using at least two-tenths of a gram of potassic cyanide to every cubic foot of space contained in the box, house or other place wherein this fumigation is performed, which place shall be gas tight, and who shall expose the said stock to the fumes of this gas of the strength aforesaid for at least forty minutes, or who shall treat the stock which they sell by some other method approved by the state nursery inspector, and who shall make affidavit before a justice of the peace that all stock sold by them has thus been fumigated or treated, and who shall attach a copy of such affidavit to each package, box or car of stock sold, shall be exempt from the provisions of sections two and three of this act.

SECTION 5. All nursery stock shipped into this state from any other state, country or province shall bear on each box or package a certificate that the contents of said box or package have been inspected by a duly authorized inspecting officer, and that said contents appear to be free from all dangerous insects or diseases. In case nursery stock is brought within the state without such a certificate the consignee shall return it to the consignor at the expense of the latter, or shall call the state nursery inspector to inspect the same: *provided, however*, that any package or box bearing a certificate of fumigation which meets the requirements specified in section four of this act may be accepted as though bearing a proper certificate of inspection.

SECTION 6. The state nursery inspector shall determine the season for inspecting nurseries and the forms of certificates to be given, but in no case shall he issue a certificate which shall continue in force after the first day of July next following the date of inspection. He or any of his deputies shall at all times have the right to enter any public or private grounds in the performance of any duty required by this act. He and each of his deputies

shall receive five dollars for each day's service required of them under this act, and the travelling and other expenses necessarily incurred in the said service.

SECTION 7. A sum not exceeding one thousand dollars may be expended by the state board of agriculture in carrying out the provisions of this act. [*Approved June 19, 1902.*

The appointment of a nursery inspector in accordance with this law was made July 22, 1902, and arrangements for the work of inspection were at once begun. Almost no knowledge of the nurseries of the State was available, their number, location and size in most cases being unknown. Accordingly, circulars were sent to more than one hundred addresses, asking for information, and from the replies received the inspection work was laid out. This took time, and, as it was also necessary to obtain certificate blanks, printed copies of the law, etc., it was August 19 before actual inspections could be begun.

Three deputy inspectors were appointed to assist in the work, viz., Messrs. E. A. Back of Florence, A. H. Kirkland of Boston and H. E. Hodgkiss of Wilkinsonville, all having had a careful training, both in field inspection and in determination methods in the laboratory. Unfortunately, no one of the deputies could devote more than a small portion of his time to the work, and, as new nurseries were continually heard of and added to the list, it was very late in the fall before the inspections were completed.

Eighty nurseries have now been inspected. Of these, fifty-seven were found to be infested in various degrees by injurious insects or diseases. At the present time sixty-five hold certificates of freedom from these pests; nine fumigate all stock sent out, working under section 4 of the law; and six have suspended all sales, while putting their nurseries into a satisfactory condition. In other words, twenty-two nurseries were found free from dangerous insects or diseases, forty-three have been cleared of these foes and are selling under certificate, and nine others secure the same result by fumigating all stock sold.

The "dangerous insect or fungous pests" met with in Massachusetts are fortunately few. The gypsy moth, brown-

tail moth, San José scale, West Indian peach scale, peach yellows, pear blight and black knot are those which have been watched for; but the San José scale and black knot have, except in a few cases, been the only ones discovered.

Black knot is rarely present on stock fit for sale, but the San José scale may be present in small numbers without being noticeable; in fact, it is probable that in four-fifths of the nurseries where it was found by the inspectors the owners were not aware of its presence, even though it was a common thing at the time of inspection to find trees ready for delivery so infested that it would be safe to guarantee their death within a year, while plants already killed by it stood in the nursery rows, the owners paying no attention to them, supposing them to have been winter-killed.

This leads to a few general statements about Massachusetts nurseries. Of the eighty inspected, the majority can be considered as in first-class condition; some, however, are being more or less neglected, and therefore ideal places for the multiplication of insects and fungous diseases, which are then distributed everywhere over the State on the stock sold from these centres of contamination.

The effect of the inspection law has been wonderfully good for such nurseries as these, as reinspection has in every case shown a weeding out of the worthless stock, and a vast improvement in every way; and it is my belief that in this regard alone the law has been worth several times its cost to the State, by improving the quality of the stock for sale.

In carrying out any law which involves the inspection of personal property, it is only to be expected that objections to it and attempts to defeat its object may be made in some cases. With this in mind, it gives me pleasure to report that only three or four such were met with in the course of the whole work. Any good business man will at once see that an expert examination of his stock and the receipt of a certificate is one of the strongest testimonials to its quality which he can obtain, and this has been quickly recognized. In the few cases where objections were made, it was where

nearly all the stock was in wretched condition, and compliance with the law would necessitate its destruction or thorough fumigation. This stock, taken all together, however, occupied less than six acres and was worth less than fifty dollars, so badly was it damaged by the various pests upon it.

The alternative of fumigating infested stock rather than destroying it, which is permitted by the law, has not generally been made use of. This is greatly to be regretted, as fumigated stock is far safer than that which has been inspected. In fact, fumigated stock has the best guarantee known, as the inspector's eye may fail to find some tiny pest somewhere, which the fumigating gas would reach and destroy. That experience in this matter will lead to a more general fumigation of nursery stock, I hope and believe. Indeed, some of the most progressive nurserymen in the State hold certificates, but nevertheless fumigate all stock they sell, both as an advertisement and as a guarantee to their customers; and it is much to be desired that more would adopt this plan.

In the course of the work thus far it has often been impossible to learn whether a person mentioned as being in the business grew nursery stock himself, or acted merely as an agent, and personal visits were sometimes necessary to determine this. Twenty-one such persons who proved to be agents only were visited, and eleven others are now being investigated with reference to this point.

In a great many cases florists whose attention is chiefly devoted to cut flowers, greenhouse plants or seeds keep a little nursery stock as a side line. The late date at which inspection began last fall made it impossible to seek out all such cases; but it will be entirely feasible to have the necessary knowledge upon which to act by the time inspections should begin another year. That this is desirable as well as required by the law is indicated by the fact that thus far the worst-infested stock has been found in the more neglected nurseries; and where nursery stock is carried only as a side line, it is generally sure to be more or less neglected.

That portion of the law bearing on the importation of stock from other States has already been of great value. Heretofore it has been the acknowledged practice of some nurserymen to ship stock to Massachusetts which the laws of other States would not permit being sent elsewhere. The Massachusetts law has now nearly put a stop to this most reprehensible practice, and with a slight amendment should entirely prevent it.

The results thus far of the passage of the nursery inspection law may be summarized by saying that it has already accomplished much for the protection of the buyers of ornamental plants and fruit and shade trees, by preventing the sale of worthless stock; has greatly aided in putting the nurseries in good condition; and has prevented the shipment of thousands of diseased and infested plants and trees into the State.

In conclusion, permit me to express my deep appreciation of the kindness and assistance I have received from you, sir, at every step in this work.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Dec. 10, 1902.

TWELFTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1903.

Dairy Bureau — 1902.

J. L. ELLSWORTH, Worcester, *Chairman.*

C. D. RICHARDSON, West Brookfield.

F. W. SARGENT, Amesbury.

Secretary.

J. W. STOCKWELL, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.

GEO. M. WHITAKER, Boston.

REPORT.

The past year has been the most notable in the history of the Bureau, for two reasons. In the first place, there has been a record-breaking amount of work done. In no previous year in the history of the Bureau have there been so many business places visited, so many prosecutions or so many convictions. In the next place, there have been several important changes in State and national laws, some of which have had a material influence on the nature of our work. Congress has placed the Massachusetts anti-color oleomargarine law on a surer footing. When the national government was organized, the States gave up to the central authority the right to regulate interstate traffic: and therefore the constitutionality of the Massachusetts anti-color law was attacked on the ground that this State had encroached upon the prerogatives of the national government by interfering with interstate commerce. The supreme court did not uphold this view of the case, but maintained that Massachusetts, in regulating the sale of an imitation product, had acted within the scope of the police powers retained by the States at the organizing of the government. This opinion, however, was not unanimous, it being the view of a majority of the judges, a strong minority dissenting. A change of two judges, by death or resignation, might have resulted in a reversal of the decision. But now Congress has given back to the States the right to legislate as to oleomargarine, and the principle of the Massachusetts law is doubly clinched. In the same act Congress increased the internal revenue tax on colored oleomargarine to 10 cents per pound, and reduced the tax on the uncolored to ¼ cent. This makes imitation butter cost 8 cents more

than formerly, and 9¾ cents more than oleomargarine which has no artificial coloration. The result of this law, which went into effect July 1, has been to diminish the effort to violate the State law by pushing the sales of imitation butter, while uncolored oleomargarine has come upon the market in large amounts. Another thing which did much to increase and broaden our work was the giving us a larger appropriation with which to enforce the "renovated butter" law.

The membership of the Bureau has not been changed during the past year, the retiring member, Mr. C. D. Richardson, having been reappointed. P. M. Harwood has continued in service as an inspector, and R. M. Horton has been succeeded by A. W. Lombard. H. M. Merriam, (Mrs.) A. A. Bangs and (Mrs.) Eva Myrick have been employed portions of the time. Others have worked for a few days occasionally, when special service was needed. The chemical work has been done, as in previous years, by Dr. B. F. Davenport of Boston and Edward B. Holland of the Hatch Experiment Station. The administrative work has continued in the same hands as heretofore.

Statistically.

Statistically, the work of the year has been as follows: —

Number of inspections,	3,895
Number of samples of butter or oleomargarine,	846
Number of samples of milk,	232
Cases in court,	285
Meetings addressed,	21

Adding the number of inspections where no samples were taken and those where the inspector took specimens, we have a total of 4,973 places visited by our inspectors during the year. The number last year was 2,668, and in 1900 2,438.

We have during the year collected evidence and presented to different courts 300 cases of violation of law. In most courts the business of receiving complaints and issuing warrants or summonses is done by the clerk, under provision of law. In Cambridge, however, the judge hears all the

evidence in advance of his trial of the cases, and authorizes the institution of proceedings only when there seems to him probable guilt. This year the judge has refused to take the word of the State officer representing this department of the Commonwealth's service as to who the witnesses in the several cases would be, and what the evidence of each one would be, demanding the personal appearance of each witness for a preliminary investigation. This not having been arranged as yet, and the cases in two other courts having been continued beyond the 1st of January, the total number of cases prosecuted to completion has been 285; but, with this reduction, we have a record of 33 cases more than last year, which at that time we felt was a phenomenal record breaker; 107 cases more than in 1900, which broke the record up to that time; and 198 cases more than in 1899. All this work means just so much service to the consuming public of the State in the interest of pure and honest dairy foods, which otherwise would not have been performed.

The charges in the several cases were as follows: —

Oleomargarine, in imitation of butter,	53
Sold as butter,	12
Wagon unmarked,	2
Wrapping paper unmarked,	10
In restaurants,	13
	90
Preservative in butter,	13
Preservative in oleomargarine,	2
Renovated butter,	120
Milk, not of standard quality,	48
Milk, adulterated,	5
Obstructing an officer,	7
Total,	285

The comparison of the court cases for 1902 and some previous years may be of interest: —

1902,	285	1898,	60
1901,	252	1897,	27
1900,	178	1896,	79
1899,	87	1895,	82

The result of these cases was as follows:—

Discharged,	10
Defaulted,	3
Nol pros.,	34
Conviction after trial, pleas of guilty or of *nolo contendere*,	238
Total,	285

Several appealed cases have been pushed to a successful termination in the superior courts in various counties; and the supreme court appeal, reported at length last year, resulted in a decision in our favor, the defendant's exceptions being overruled.

Oleomargarine.

The disparity of 9¾ cents per pound in the case of colored oleomargarine and white oleomargarine has driven much of the former imitation butter out of the market, and led the manufacturers to make a determined effort to get the uncolored article before the consuming public. This has done much to modify the nature of our work, and the results. We have been unable to relax our vigilance as regards oleomargarine colored in imitation of yellow butter. Although less of it has been sold in the State than heretofore, we have been obliged to keep a constant watch for it, as in many cases it has been in evidence: and we have had in court this year, as will be seen by the above table, 53 cases, as against 88 last year, 145 the year previous, 47 in 1899 and 13 in 1898. On the very last day of the year, December 31, our inspectors found two dealers handling the imitation article in cities in different parts of the State. The uncolored oleomargarine has also increased our work, for all of the laws heretofore existing relative to stamps, brands, signs, etc., apply to all kinds of oleomargarine, regardless of color. Hence we were obliged to inspect the dealers handling oleomargarine without artificial color, to see if the laws were complied with. The result has been that, instead of bringing cases under only two different laws, as was the case for the three previous years, in 1902 we made complaints for violation of five laws. Sometimes

we have found the white oleomargarine sold as butter, though in most of these the offenders were small dealers, some of them not familiar with our language and laws. In such instances we believed there was no intention of violating the law; but in one case a peddler, who was asked by an inquisitive customer why the butter was so white, replied that "Vermont had just passed a law against coloring butter."

The fluctuation of the oleomargarine business in Massachusetts, as indicated by the number of people paying the United States tax, is very significant. When the anti-color law was passed, in 1891, 485 people were paying a tax to sell imitation butter in this Commonwealth, — 34 at wholesale, 451 at retail. The number was gradually reduced under the operation of the law, until in the years ending June 30, 1897 and 1898, there were only 29 of these tax payers, one to do a wholesale business and 28 a retail business; and in 1898 the number of cases we had in court for violating the anti-color law was as low as 13. But with the national fiscal year ending June 30, 1899, there became evident a strenuous attempt on the part of the oleomargarine people to push more sharply than ever, and more openly and wilfully to violate the State law. The number of persons paying this tax for that year increased to 88, and for the year ending June 30, 1901, to 109; while the number of our court cases increased in the year 1900 to 178, 145 of these being for a violation of the anti-color law. This sharp fight put up against the law breakers had the effect to curtail the business, and the number of taxes fell off more than one-half the next year; but with the advent of the uncolored oleomargarine the number has increased to 346.

So far the consuming public has not taken hold of the uncolored oleomargarine very readily, preferring the color of butter. Should success attend the efforts to educate consumers to prefer a lighter-colored butter and to use uncolored oleomargarine in any considerable quantities, the latter would become an important factor to be considered commercially. But the moral question would be eliminated, for the light-colored oleomargarine would not be a fraud, and would

be sold honestly. Some manufacturers are straining hard to inch up in the matter of color, and some brands are now on the market which, in our opinion, are very close to "imitations of yellow butter."

The number of persons who paid a United States tax the past seven years is shown by the following table: —

Years ending June 30 —	Wholesale.	Retail.
1897,	1	28
1898,	1	28
1899,	12	76
1900,	3	59
1901,	6	103
1902,	3	48
Current year, — colored,	1	24
Current year, — uncolored,	7	314

Renovated Butter.

Last year's Legislature gave us an increased appropriation, so that we could enforce the "renovated butter" law. This is a law which requires identifying marks on tubs and boxes when it is in bulk, and on the wrapping paper in case of small sales. By reason of delays, the legislation was not perfected until half of the year had passed; we have in the remaining half of the time expended about one-half of the appropriation.

At first we took pains to give dealers information as to the law; many copies of it were printed and circulated among the trade. In spite of this, when we began taking samples and making purchases, we found many violations of the law. In most instances, at first, the dealers thus caught were persons of honest instincts, who intended to comply with the laws of the Commonwealth, but who had not become familiar with this particular statute, in spite of our efforts to disseminate information concerning it. These

dealers were an entirely different class of people from those who had been violating the oleomargarine (imitation butter) law, and therefore the former had a much better standing in court. This phase of the case gave rise to considerable perplexity, as we felt it necessary to proceed with great care and discretion, in order to do our duty faithfully and have the objects of the law secured, with a minimum of hardship and seeming oppression.

In most cases hitherto where the charge had been a violation of the "imitation butter" law there had been an evident intent or a studied purpose to evade the law. That was different in these violations of the "renovated butter" law, and hence we have had an unusual number of appeals for recommending leniency to the courts.

Another cause of some embarrassment has been the large penalty attached to the law, — a minimum of one hundred dollars, with no latitude to the courts for mitigating circumstances except placing the case on file. Nevertheless, we believe the statute is very useful, both for consumers and producers. Previously, renovated butter was sold deceptively in nearly every instance. When put up in prints, it was labelled in a way particularly calculated to deceive the ordinary consumer. We have found it with such labels about each individual print as "Franklin County Creamery," "Sweet Clover Creamery," "Fancy Creamery-Iowa Brand-Pure Butter," with nothing to show the real character of the article. Even after there began to be an enforcement of the law, the spirit of deception was not summarily exorcised, but in most cases it was attributable to the manufacturers rather than to the retailers in whose hands we found the goods.

In Worcester over a dozen samples were taken where the words "renovated butter" on the wrapper were printed so dimly as to be almost imperceptible. Another batch of samples was labelled "Litchfield County Print Butter, put up expressly for family use, every package guaranteed," while the words "renovated butter" were in small, skeleton letters, smaller than the law required. Another wrapper bore the mark "Meadow Brook-Pure Butter-Creamery," with the words "renovated butter" in skeleton type, which

would hardly be recognized by the average purchaser. As the work of enforcing the law has progressed, these deceptive wrappers have to a very large extent disappeared, and more honest ones have taken their place. In this connection great assistance has been rendered by the United States law, which was added as a sort of rider to the Grout oleomargarine bill. Under this United States law a revenue tax of one-quarter cent a pound is imposed upon renovated butter, and there are a number of useful requirements as to brands, marks and stamps.

In case of marks on the outside wrapper, when two or more purchases are made and all packages are placed in an outside wrapper for the convenience of the customer in diminishing the number of parcels, the Attorney-General gives us the opinion that "the outside of the parcel containing the several parcels of merchandise, within the law, does not require the specific label if such be upon each of the parcels originally made up and delivered to the purchaser. Such delivery is, in my opinion, the delivery contemplated by the statute; and if, after such delivery, the customer requests, and in compliance with such request, expressed or implied, the seller, as agent for the purchaser, makes up the larger bundle, such transaction is no part of the original delivery; and, the law having been complied with as to each of the original packages, no further labels need be affixed by the seller."

In connection with the new national law, considerable was said in newspapers and elsewhere about the use of various preservatives in renovated butter; and, with a view of studying the way the business was transacted in Massachusetts, we caused a number of samples to be analyzed. Boracic acid was found in about one-third of them, and thirteen cases were entered in court under the general food law, which declares a substance adulterated if any antiseptic or preservative is used except common salt, saltpetre, spices, alcohol and sugar. The manufacturers defended the cases, but became satisfied that the Massachusetts law was valid and was to be enforced. They have therefore agreed to use no more boracic acid in the butter which is put upon the Massachusetts market.

Butter.

The market has been in a healthy condition through the year, with prices very high, averaging much more than any records which we have kept during the past seven years. During that time anything in excess of 29 cents has been reported but once: in January, 1900, 29½ cents was reached. During the past year in April the price went as high as 32 cents. Another peculiarity of the year 1902 was the fact that August averaged the lowest month, whereas May and June are ordinarily the low months of the year. The lowest quotation for any one week was the first week in September. The somewhat phenomenal advance in March and April let out the holders of storage butter at a good margin. For almost every month the price has been higher than for the average of the corresponding months of previous years.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last seven years: —

	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.	1898. Cents.	1897. Cents.	1896. Cents.
January,	25.0	25.0	29.5	21.0	22.5	22.0	26.0
February,	28.5	25.0	26.0	24.0	21.5	22.0	24.0
March,	29.0	23.0	27.0	22.5	22.0	23.0	24.0
April,	32.0	22.0	21.0	21.0	22.5	22.0	22.0
May,	25.0	19.5	20.5	19.0	18.0	18.0	17.0
June,	23.5	20.0	20.5	19 0	17.5	16.0	16.5
July,	22.5	20.0	20.5	19.0	18.5	16.5	16.5
August,	21.5	21.0	22.5	21.5	19.5	19.0	17.5
September,	23.5	22.0	22.5	23.5	21.0	22.0	17.5
October,	24.5	21.5	22.0	24.0	21.5	22.5	20.0
November,	27.0	24.0	25.0	26.5	21.0	22.0	21.0
December,	28.5	24.5	25.5	28.0	21.0	23.0	23.0
Averages,	25.0	22.3	23.5	22.4	20.5	20.6	20.4

The Chamber of Commerce figures regarding the butter business in Boston for 1902 and the immediately preceding years are as follows: –

	1902. Pounds.	1901. Pounds.	1900. Pounds.	1899. Pounds.	1898. Pounds.	1897. Pounds.
On hand January 1,	4,512,000	3,285,960	2,073,800	2,829,160	2,473,600	2,898,000
Receipts for the year,	54,574,429	57,499,836	51,502,840	49,757,606	50,609,552	51,107,033
Total supply,	59,086,429	60,785,796	53,576,640	52,586,766	53,083,152	54,005,033
Exports, deduct,	940,031	5,708,603	1,002,374	3,051,710	1,574,682	3,286,333
Net supply,	58,146,398	55,077,193	52,574,266	49,535,056	51,508,470	50,718,700
Stock on hand December 31, deduct,	6,248,920	4,512,000	3,285,960	2,073,800	2,829,160	2,620,680
Consumption,	51,897,478	50,565,193	49,288,306	47,461,256	48,679,310	48,098,020

This shows an increased consumption, one million and a third pounds more than for the year 1901, and an average weekly consumption of about one million pounds. The table shows a steady increase in the consumption of butter from year to year, and the actual increase is much more than the figures show, because Boston is supplying a more and more restricted territory. Worcester, New Bedford, Lawrence and other cities are steadily becoming greater distributing centers, and are therefore supplying consumers who formerly received their product from the Boston market.

Creameries in Massachusetts.

LOCATION.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	– –	Co-operative,	F. J. Humphrey, agent.
Ashfield,	– –	Co-operative,	Sanford Boyce, president.
Belchertown,	– –	Co-operative,	M. G. Ward, president.
Bridgewater,	Plymouth County,	Co-operative,	P. O. Clark.
Charlemont,	– –	Proprietary,	T. M. Totman.
Cheshire (P. O., Adams),	Greylock,	Co-operative,	C. J. Fales.
	Highland,	Proprietary,	Clayton W. Prince.
	West Shore,	Proprietary,	Seth W. Curtiss.
Chester,	– –	Co-operative,	J. H. Keefe, treasurer.
Conway,	– –	Co-operative,	J. B. Packard, president.
Cummington,	– –	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	– –	Co-operative,	H. O. Harrington.
Framingham,	– –	–	– –
Heath,	– –	Proprietary,	D. B. Dunham.
Hinsdale,	– –	Co-operative,	B. C. Bliss.
Lee,	– –	Proprietary,	Jas. Lee.
Monson,	– –	Proprietary,	W. C. Moulton.

Montague,	– –	Co-operative,	A. M. Lyman, president.
Monterey,	Berkshire Hills,	Co-operative,	Arthur Miner.
New Boston,	Berkshire,	Co-operative,	C. D. Sisson, Sandisfield.
New Salem,	– –	Co-operative,	W. A. Moore.
North Brookfield,	– –	Co-operative,	Richardson & Granger.
Northfield,	– –	Co-operative,	L. R. Smith.
Orange (P. O., North Orange),	– –	Co-operative,	Jonathan Holt.
Oxford (P. O., North Oxford),	Cold Spring,	Co-operative,	C. H. Wellington.
Shelburne Falls,	– –	Proprietary,	Rufus Covell.
Southborough,	Deerfoot Farm,	Proprietary,	R. M. Burnett.
Southfield,	Maple Lawn,	Co-operative,	A. C. Lockwood.
Uxbridge,	Blackstone Valley,	Co-operative,	E. H. Farnum.
	Farnum,	Proprietary,	Geo. A. Farnum.
Warren,	Worcester County,	Co-operative,	Calvin Bliss.
Wellesley,	– –	Co-operative,	– –
Westfield (P. O., Wyben),	Wyben Spring,	Co-operative,	C. H. Wolcott.
West Newbury,	– –	Co-operative,	S. O. Ordway.
Williamsburg,	– –	Co-operative,	E. T. Barrus, president.
Worthington,	– –	Co-operative,	J. B. Pease.
Boston,	388 Rutherford Avenue,	Proprietary,	Boston Dairy Company.
	38 Huntington Avenue, Hobart Farm Creamery,	Proprietary,	J. W. Hobart

Creameries in Massachusetts — Concluded.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Boston,	172 Washington Street,	Proprietary,	Henderson Dairy Company.
	394 Rutherford Avenue,	Proprietary,	H. P. Hood & Sons.
	203 Clarendon Street, Walker-Gordon Laboratory,	-	-
	472 Rutherford Avenue,	-	D. Whiting & Son.
Boylston,	Adelphia,	Proprietary,	E. M. Laws.
Brockton,	-	-	Brockton Dairy Company.
Cambridge,	158 Massachusetts Avenue,	-	C. Brigham Company.
Everett,	-	-	New England Creamery Company.
Fitchburg,	-	Proprietary,	C. S. Learned.
Haverhill,	-	-	C. H. McCormick.
Hingham,	Hingham Dairy Association,	-	-
Leominster,	-	-	G. S. Wass.
Marlborough,	-	Proprietary,	F. F. Este.
North Adams,	North Adams Milk Association,	Proprietary,	C. M. Bull.
Springfield,	Springfield Milk Association,	Co-operative,	F. B. Allen.
Worcester,	Wachusett,	Proprietary,	-

When the creamery movement started in Massachusetts nearly all of the creameries were co-operative, and statistics connected with them were regarded as of a great deal of value, because every farmer and milk producer had an interest in the outcome of the operations of the creameries. The competition with the sale milk business in Boston, and other reasons, have made considerable of a change in this respect, and, as will be noticed by the above list, many of the creameries are now proprietary. Some of the co-operative creameries have continued, and we compile the following from their latest reports, showing something of their general methods: —

BELCHERTOWN. — Amount of cream collected, 906,356 pounds. From this were made 201,352 pounds of butter after selling cream to the value of $485. The total receipts for the year were $55,131. The amounts paid were as follows: —

Gathering cream,	$3,076 00
Making butter,	1,040 00
Selling and delivering,	919 00
Freight and express,	401 00
Patrons for cream,	42,526 00
Officers,	637 00
Testing cream,	48 00
Discounts,	299 00
Other expenses,	1,431 00

MONTAGUE. — This creamery received 287,467 pounds of cream, and made 68,084 pounds of butter. The average price of the butter was 25.24 cents per pound, and the average paid for butter fat was $24\frac{1}{12}$ cents.

HAMPTON. — Received 890,823 pounds cream, producing 161,159 pounds butter. The receipts of the year were $50,649.85. Payments were as follows: —

Paid patrons,	$41,389 67
Ordinary expenses,	6,628 57
Dividends, 6 per cent,	150 00
Balance to new account,	2,481 61
	$50,649 85

HINSDALE CREAMERY. — Made 103,701 pounds butter. Its total receipts were $25,529.55. The payments were as follows: —

Patrons for cream,	$19,503 43
Expenses,	4,428 77
Dividend on capital stock, 1900, 5 per cent,	171 25
One-half cent reserve,	523 30
Supplies sold patrons,	15 08
Error,	54
Cash on hand,	887 18
	$25,529 55

CONWAY CREAMERY. — Made about 420,000 pounds butter, and sold about 28,600 pounds which it had to purchase from other sources. Its sales of cream and butter amounted to about $125,000, and disbursements to patrons for cream $100,575.

EGREMONT CREAMERY. — Received 735,751 pounds cream, and made 157,045 pounds butter. The total receipts were $36,453.61, expenses were $5,853.55, the balance going to the farmers who produced the cream.

MILK.

During the year the milk market has been in the main firm in price, with a fair demand and no great amount of surplus. The cold summer caused a marked falling off in the amounts of milk and cream used at summer resorts, and producers dependent upon that kind of a market did not do as good a business as in some years. Later in the year the colder weather, coupled with the outbreak of the foot and mouth disease, caused a material shortening of the supply. The retail price of milk in the various towns and cities of the State varies somewhat, according to local competition, but is within the limits of 6 and 8 cents for ordinary milk. Fancy certified milk, of extra quality, sells at a higher price.

Some things have come to our knowledge during the year which convince us that a certain class of city peddlers do quite a business in what may be called blended milk. They prepare an article which is uniform in composition, and substantially up to the standard. During the 12 per cent months they sell milk of about 11.8 per cent solids, and when the standard advances to 13 per cent, by some form of lacteal necromancy their product easily follows the standard. We believe they would have no trouble in furnishing a milk of a greater per cent of solids, should the law require it. As reported in another place, we took 232 samples of milk during the year, and had 53 cases in court.

The amount of total solids in the milk, where the charge was milk below the standard, was as follows: —

10.20	11.92	11.12	10.84
11.78	12.32	11.76	9.92
11.26	12.52	11.02	11.22
11.90	12.50	11.72	11.76
12.22	12.52	11.22	11.76
11.36	12.42	11.36	11.14
11.76	11.44	11.86	11.32
11.60	11.70	11.62	10.26
11.10	10.40	11.62	9.56
11.56	11.76	11.74	10.38
11.80	10.50	11.54	10.76
12.38	11.44	11.30	10.80

The price of Boston milk has been higher than for many years. At the meeting in the spring, to fix prices, the directors of the milk producers union asked for 36 cents as a Boston price, less an agreed "surplus discount" of 2 cents, making a "straight price" of 34 cents. The contractors offered 1 cent less, with provisions tending to promote a more even production. The matter was finally adjusted by a compromise, by which 36 cents was made the price for April, July, August and September, and 35 cents for May and June. At the time of making the price for October there were a number of protracted conferences, which resulted finally in a trade for 39½ cents as the Boston price, and 37½ cents as the net price. In addition to this, the contractors agreed that the word "surplus" was not to appear in negotiations with producers, and that no alternative propositions were to be made. The surplus provisions having disappeared from the contracts, the contractors felt under no obligations to continue giving the figures of receipts and sales, and consequently we are unable to get that statistical information for this report, much to our regret. In other lines of business, full statistics are regarded as essential to intelligent action.

The following table shows the price of Boston milk for the past ten years, the report for last year giving the figures for eleven years previous to that. It should be understood, by way of explanation, that previous to 1900 farmers received a specified long price for what milk could

be sold as sale milk, and butter value for the surplus. Under this trade they received two prices for milk, the average price being a little less than the long price for sale milk; the amount of discount depended on the amount of surplus and on the price of butter. The contractors, for convenience in bookkeeping, figured all of the milk at the long price, and then applied to the result a discount which would give, as the balance, the proper amount to be paid to the farmers. In this way the expression "surplus discount" or "discount on account of surplus" came into existence. That way of doing business, in its practical operation, having many evils and having become unpopular, the old-time method of getting at the net average price has been abolished, and the long price has been arbitrarily reduced 1½ and 2 cents, in lieu of a surplus discount, figured on the actual conditions as to amount of surplus and value of butter.

The price that the farmer received has been a fixed discount from this, varying according to the distance from Boston. We have included in the table the price which the producer in the middle belt has received during this time, the price being what he has received for all milk consumed as such in Boston, and not the average income of his dairy when both sale milk and butter value of surplus are considered and averaged. The figures are for 8½ quart cans.

Summer Price.

	Gross Boston Price (Cents).	"Straight Price," Boston (Cents).	Gross to Producer, Fifth Zone (Cents).	Straight Price to Producer, Fifth Zone (Cents).
1893, April to October, . .	33	–	22	–
1894, " " . .	33	–	22	–
1895, " " . .	33	–	22	–
1896, " " . .	33	–	22	–
1897, " " . .	31*	–	22	–
1898, " " . .	31	–	22	–
1899, " " . .	31	–	22	–
1900, " " . .	33	–	24	–
1901, " " . .	33	31	24	22
1902, " " .	36 in April, July, August, September.	34 in April, July, August, September.	27	25
	35 in May, June.	33 in May, June.	26	24

* This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Winter Price.

	Gross Boston Price (Cents).	"Straight Price," Boston (Cents).	Gross to Producer, Fifth Zone (Cents).	Straight Price to Producer, Fifth Zone (Cents).
1893-4, October to April, .	37	-	26	-
1894-5, " " .	37	-	26	-
1895-6, " " .	37	-	26	-
1896-7, " " .	35	-	24	-
1897-8, " " .	33*	-	24	-
1898-9, " " .	33	-	24	-
1899-0, " " .	33	-	24	-
1900-1, " "	37 to January. 35 to April.	-	28 to January. 26 to April.	-
1901-2, " "	36 40 in December.	34½ 38½ in December.	27 31	25.5 29.5
1902-3, " " .	39½	37½	30½	29

* This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Educationally.

The work of the Bureau is unique and different from that of any other department of the State government, because, under the statute, there is broad educational work as well as police duties. No other State department having police duties is required to do similar work along the line of collecting and disseminating information. During the last year the amount of educational work done has been less than usual, though the general agent has responded to about the average number of calls for addresses. In the discharge of this part of his work, he has spoken to 20 different gatherings. Last year the number was 14, and the year before it was 19. At a number of these meetings object-lesson demonstrations of the Babcock test have been given, nearly 150 samples of milk having been tested in that manner. The general agent has again been called upon to award the sweepstakes dairy prize for the Worcester South Agricultural Society, based on the amount of butter fat produced on the grounds of the society by individual cows in twenty-four hours. The following table gives the results of the test for the past year: —

OWNER.	Breed.	Pounds Milk.	Per Cent Fat.	Pounds Fat.
J. E. Kimball, Oxford, . .	Jersey, "Rosa," . .	12.87	5.8	.75
		10.00	4.8	.48
		22.87		1.23
A. L. Woodis, North Brookfield,	Ayrshire, . . .	17.25	3.4	.586
		14.87	4.0	.595
		32.12		1.181
J. E. Kimball, Oxford, . .	Jersey, "Daisy," . .	12.00	5.0	.60
		11.94	4.6	.55
		23.94		1.15
J. E. Kimball, Oxford, . .	Jersey, "Princess," .	11.87	5.2	.617
		10.75	4.8	.516
		22.62		1.133
C. L. Underwood, . . .	Guernsey, "Daisy," .	16.75	3.4	.57
		17.62	3.2	.56
		33.37		1.13
G. H. Bowker, ...	Ayrshire, . . .	17.00	3.2	.54
		14.50	4.0	.58
		31.50		1.12
A. L. Woodis, ...	Ayrshire, . . .	13.87	3.4	.47
		14.87	3.8	.56
		28.74		1.03
J. E. Kimball, ...	Jersey, "Beauty," .	12.75	4.4	.56
		11.75	4.0	.47
		24.50		1.03
E. D. Cole, Barre Plains, . .	Reg. Holstein, . .	17.37	3.0	.52
		17.12	3.0	.51
		34.49		1.03
C. L. Underwood, ...	Guernsey, "Gypsy," .	11.25	4.8	.54
		11.50	4.2	.48
		22.75		1.02
C. L. Underwood, . . .	Guernsey, "Belle," .	14.00	3.2	.45
		13.75	3.2	.44
		27.75		.89

In addition, there has been published a compilation of the Revised Laws relating to dairy matters and the decisions of the supreme court on the same, edited to conform to the new numbering of the Revised Laws.

Expenses.

The following is a classified statement of the expenses of the year: —

Agents' salaries,	$1,914 05
Agents' expenses,	2,581 68
G. M. Whitaker, general agent, for travelling expenses, postage, mileage, etc.,	821 03
Chemists,	2,790 75
Bureau,	346 20
Supplies and printing,	152 11
Educational,	12 33
Total,	$8,618 21

GEORGE M. WHITAKER,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

J. LEWIS ELLSWORTH.
CARLTON D. RICHARDSON.
FRED. W. SARGENT.

SECOND SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS STATE BOARD OF AGRICULTURE.

JANUARY 10, 1903.

REPORT.

To the State Board of Agriculture.

I have the honor to submit the second semiannual report of the Cattle Bureau of the State Board of Agriculture, as provided for in section 3 of chapter 116 of the Acts of 1902. This report will be more in detail than the first semiannual report, made last July, and is intended to supplant the annual report formerly made by the Board of Cattle Commissioners to the Legislature.

In order to have it a complete report of the year's transactions, it will be necessary to include in it the work done by the Cattle Commission from Dec. 15, 1901, until it was succeeded by the Cattle Bureau, April 15, 1902. The annual report of the Cattle Commission has always been carried from the 15th of one December until the 15th of the December following, as it was impossible to bring it up to the first of January in season to have it ready at the time required. This plan will be followed here, with the exception that that portion relating to foot and mouth disease will be brought up to the first of January.

In addition to the ground covered by the reports of the past few years, including work done toward the suppression of tuberculosis among cattle, glanders among horses, symptomatic anthrax, actinomycosis, rabies and infectious swine diseases, this Bureau has had to deal with a small outbreak of Texas fever, and also with a somewhat extensive outbreak of foot and mouth disease. The latter, coming in the middle of November, has taxed the resources of the force of the office to its utmost capacity. The report, therefore, will deal with this outbreak fully, but will have to be very brief in connection with other diseases, owing to the lack of time necessary for preparing a full and detailed account of the year's work.

Financial Statement.

The following financial statement shows the amount of money appropriated for the use of the Cattle Commission and Cattle Bureau, and the expenditures that have been made : —

At the date of the last annual report of the Board of Cattle Commissioners, Dec. 15, 1901, there remained of the appropriation for the year 1901 an unexpended balance of $4,606.98 ; and there was appropriated by chapter 210, Acts of 1902, for use of the Board to April 15, 1902, $8,000, making a total of $12,606.98.

The amount expended to April 15, 1902, when the Board of Cattle Commissioners was abolished under the provisions of chapter 116, Acts of 1902, was as follows : —

For 216 head of cattle condemned and killed as tuberculous,	$4,331 50
For salaries of commissioners,	1,585 00
For expenses of commissioners,	601 73
For salaries of agents,	1,168 00
For expenses of agents,	674 52
For salaries of clerks and stenographers,	731 00
For stationery, postage, printing and other office expenses,	284 62
For laboratory and experimental work,	91 00
For implements, tuberculin, etc.,	103 72
For expense of quarantine stations at Brighton, Watertown and Somerville,	924 44
For expense of glanders work,	1,720 12
Total,	$12,215 65

This leaves a balance to the credit of the Board of Cattle Commissioners, April 15, 1902, of $391.33.

Of the expenditures as given, $4,219.22 was for payment of bills of 1901, and $7,996.43 for bills from Jan. 1 to April 15, 1902.

The appropriation for the "extermination of contagious diseases among horses, cattle and other animals," to be expended under the direction of the Chief of the Cattle Bureau of the State Board of Agriculture, from April 15 to Dec. 31, 1902, made by chapter 303, Acts of 1902, was $50,000.

There has been expended to Dec. 15, 1902 : —

For 785 head of cattle condemned and killed as tuberculous,	$16,806 25
For salary of Chief of Cattle Bureau,	1,125 00
For expenses of Chief of Cattle Bureau,	128 54
For salaries of agents,	3,308 50
For expenses of agents,	1,863 70
For salaries of clerks and stenographers,	1,399 00
For printing, postage, stationery and other office expenses,	1,356 33
For laboratory and experimental work (exclusive of glanders work),	230 08
For implements,	179 74
For expense of quarantine stations at Brighton, Watertown and Somerville,	3,390 87
For expense of glanders work (including laboratory work),	3,424 98
Total,	$33,212 99

This leaves a balance of $16,787.01 to meet outstanding unsettled accounts and to carry on the work of the Bureau until Dec. 31, 1902.

It will be seen from the above that a balance of nearly $17,000 was on hand after paying the bills that came in December 1, which was ample for meeting the emergency caused by the outbreak of foot and mouth disease. It is probable that, after paying the bills for the financial year, claims for quarantine expenses, from owners who had cattle quarantined because of foot and mouth disease, may be sufficient to cause a deficiency in the appropriation made for the use of the Cattle Bureau in 1902. Whether this will be the case or not cannot very well be determined at the present time.

The object in reporting the outbreak of foot and mouth disease at once to the federal authorities was to save the State expense as far as possible, the national government having furnished a large number of the veterinarians necessary for inspecting animals, and seeing that they were slaughtered, and also bearing a large share of the expense for disinfecting; the United States also paying 70 per cent of the appraised value of the animals. If later the Legislature decides that the owners of animals destroyed should receive the other 30 per cent, the expense to the State will not be very much, $30,000 or $40,000 ought to settle all such claims.

The law requires that a report of the inspectors of animals be incorporated in the annual report of the Cattle Commissioners, and it seems that the intent of the law is that this statement of the condition of the live stock of the State shall be embodied in the report of the Chief of the Cattle Bureau at the close of each year. Owing to the appearance of foot and mouth disease so near the end of the year, it has been impossible to compile the reports of the inspectors of animals. All that can be said is, that the usual annual inspection was ordered October 1, to be completed by November 15. Returns from the inspectors of animals have been received from all the cities and towns in the State except the following twenty-three: Arlington, Athol, Beverly, Dedham, Hamilton, Hampden, Hardwick, Leominster, Littleton, Malden, Maynard, Mount Washington, New Braintree, North Andover, North Reading, Petersham, Quincy, Revere, Southbridge, Stoughton, Swampscott, Waltham and Weston. These returns show that up to the middle of November, at which time foot and mouth disease was first called to the attention of the Cattle Bureau, the condition of the live stock of the State was very satisfactory, and the animals were looking well. There seems to be a tendency among many farmers to improve the sanitary surroundings of their stock from year to year, and to pay more attention to their management and care.

Tuberculosis.

As it is the chief item of expense, tuberculosis will be mentioned first. As usual, it may be divided under three heads.

First. — Animals quarantined by the local inspectors as having tuberculosis, or as having been brought into Massachusetts from outside the State, and held in quarantine until satisfactory evidence of a tuberculin test was presented to the Chief of the Cattle Bureau.

The following is a statement of the work done under the first section: —

During the year ending Dec. 15, 1902, there have been quarantined in 245 different cities and towns of the

State, on suspicion of being affected with a contagious disease: —

Massachusetts cattle,	1,956
Cattle coming from without the State,	477
Total,	2,433

Of these, there were: —

Massachusetts cattle released,	544	
Out-of-State cattle released,	391	
		935
Massachusetts cattle condemned, killed and paid for,	891	
Out-of-State cattle condemned, killed and paid for,	7	
		898
Massachusetts cattle, permit to kill and paid for,		20
Massachusetts cattle, permit to kill, no award,		81
Massachusetts cattle died in quarantine, no award,		66
Out-of-State cattle, condemned and killed, no award,		52
Massachusetts cattle, condemned and killed (in process of settlement),		335
Out-of-State cattle, returned to State whence shipped,		19
Massachusetts cattle, in quarantine, not reported upon,	19	
Out-of-State cattle, in quarantine, not reported upon,	8	
		27
Total,		2,433

Thirty-three cattle, quarantined by inspectors early in the year, before an appropriation had been made for the work, were released for lack of funds to pay for the animals.

Reports have been made by renderers, butchers and inspectors upon animals not quarantined, but found tuberculous at time of slaughter, as follows: —

Cattle,	68
Calves,	1
Swine,	5
Total,	74

Some of the cattle quarantined by the local inspectors have been badly diseased, and a few have had tuberculous udders. Such animals are certainly unfit to furnish milk for human consumption, besides being a greater source

of danger to other cattle than those that are but slightly diseased.

Second. — In connection with the cattle brought to the stock yards at Brighton, Watertown and Somerville, as well as animals brought in on permits from other points throughout the State.

The work at the stock yards has been in charge of Mr. C. A. Dennen, as agent of the Cattle Bureau. The following tables show receipts at Brighton, Watertown and Somerville during the year, and also the total receipts at the three stations: —

Receipts of Stock at Brighton from Dec. 15, 1901, to Dec. 15, 1902.

Maine cattle,	9,179
New Hampshire cattle,	1,858
Vermont cattle,	606
New York cattle,	538
Massachusetts cattle,	12,994
Rhode Island and Connecticut cattle,	207
Western cattle,	42,869
Sheep,	47,294
Swine,	1,176,960
Veal,	41,198
Cattle released on certificates,	2,877
Cattle tested,	7,245
Cattle released after test,	7,164
Cattle condemned after test,	81
Cattle at market (sold from stock barn),	25,260

Receipts of Stock at Watertown from Dec. 15, 1901, to Dec. 15, 1902.

Vermont cattle,	7,426
New Hampshire cattle,	5,304
Massachusetts cattle,	2,886
New York cattle,	31
Western cattle,	51,777
Sheep,	401,783
Swine,	194,355
Veal,	64,192
Cattle released on certificates,	3,749
Cattle tested at station,	47
Cattle released after test,	42
Cattle condemned after test,	5

Receipts of Stock at Somerville from Dec. 15, 1901, to Dec. 15, 1902.

Maine cattle,	1,279
New Hampshire cattle,	5,326
Vermont cattle,	5,970
Massachusetts cattle,	4,312
New York cattle,	1,081
Western cattle,	38,936
Sheep,	396,192
Calves,	59,755
Hogs,	34,231
Released on certificates,	728

Cattle not for immediate slaughter have been tested at Brighton by the Cattle Bureau, and are included in the Brighton report.

Total Stock received at the Three Stations from Dec. 15, 1901, to Dec. 15, 1902.

Cattle,	192,579
Sheep,	845,269
Swine,	1,405,546
Veal,	165,135
Cattle released on certificates,	7,354
Cattle tested at stations,	7,387
Cattle released after test,	7,274
Cattle condemned after test,	113

Owing to the unsatisfactory manner in which animals brought into the State were tested, an order was issued, which took effect September 30, providing that all cattle brought to the quarantine stations at Brighton, Watertown and Somerville, except beeves for immediate slaughter and calves under six months old, shall be tested by the agent of the Cattle Bureau and his assistants.

The above tables show a larger number of animals tested at these stations by the State than any previous year, because of this order. The cattle are tested Tuesday and Wednesday, in season to have the test completed at ten o'clock Wednesday morning. Any that appear to react are held over and tested the next week. If an animal reacts a second time, it is either killed, or the owner returns it to

the State it came from, if he can get a permit from the authorities of his State to do so.

Owing to the outbreak of foot and mouth disease, the Brighton market has been closed since November 26; otherwise, a larger number of cows would have been brought from without the State than has been received.

Below is given a report of cattle brought to points outside the stock yards during the year on permits: —

Report of Cattle brought into the State during the Year, to Points outside the Quarantine Stations at Brighton.

During the year 1902, 569 permits were issued to bring animals into Massachusetts, 69 of which were not used. On the balance, the following cattle were brought in: —

For dairy and breeding purposes, tested before shipment,	2,843
For dairy and breeding purposes, tested after shipment,	1,717
Calves under six months old, requiring no test, . .	118
Cattle returned from out-of-State pastures, . . .	911
Cattle to be pastured and returned to Rhode Island, .	32

Forty-two permits were for cattle for immediate slaughter, 16 being for a carload or more weekly. On these permits a great many cattle were brought in for beef, the exact number not being recorded. Two permits gave the privilege of bringing in cattle to be fattened and sold for beef later; 1 allowed cattle to be driven back and forth daily between Connecticut and Massachusetts; 3 allowed cattle to pass through the State; and 3 gave owners the privilege of bringing cattle into Massachusetts for exhibition purposes; 1 permit was issued to bring one sheep into the State; 1 for one carload of lambs, calves and hogs; and 2 permits were issued allowing hogs to be transported from one town to another within the State limits. Permission was also granted for a yoke of oxen to be driven back and forth between Massachusetts and Connecticut for transportation purposes.

Besides the above, railroad agents, local inspectors and others have reported 382 cows, 11 bulls, 16 oxen and 6 calves that have been brought into the State without permission. Of these, 10 head of cattle were en route to New York State; 2 cows, through a misunderstanding, were sent,

before being tested, to Brighton market; 24 head of cattle were slaughtered for beef; and 1, for which a certificate of test was received and approved, has not yet been located. With these exceptions, the cattle have all been looked up and tested.

Third. — This section is included under what is known as voluntary request work, owners of herds asking to have them tested. The animals have been tested at the request of the owner, on condition that he would agree to take what he could get from the butcher for animals that were so slightly diseased as to pass as fit for beef, the State paying for the badly diseased creatures, sending an agent to make the test free of expense to the owner, and furnishing the tuberculin.

More work of this kind could be done if the appropriations were larger, and it was not necessary to put so much of the burden on the owners. Many farmers do not feel that they can afford to take what the beef and hides of their animals bring, as many of them are milch cows, and are worth very little for beef. It ought to be possible for owners who have tuberculosis in their herds to have the assistance of the State in bringing about a better condition of health, as it is of benefit to the community as well as to the owner.

Below is given a report of cattle tested under this section: —

Number of herds,		17
Number of animals,		274
Number condemned, killed and paid for,	55	
Number killed, no award,	56	
Number released,	151	
Number died in quarantine,	1	
Number held for retest,	9	
No report,	1	
Number killed, unsettled,	1	
Total,	—	274

Since Professor Koch's statement that there is but little or no danger to human beings from the use of products of tuberculous cows, it has made further investigation necessary. The following experiments, conducted by Dr.

Theobald Smith at the Bussey Institute, may prove interesting: —

October 14, four young cattle were bought at Brighton and sent to Bussey Institute, after being tested with tuberculin and found free from disease. One, a heifer, ear tag No. 687, fifteen or eighteen months old, grade Jersey, was inoculated in the right lung, between the seventh and eighth ribs, with a culture of bacilli resembling those found in human tuberculosis.

No. 625, grade Holstein bull, about a year old, was inoculated above the right flank into the peritoneal cavity with part of a culture resembling human tubercle bacilli.

Ear tag No. 696, grade Holstein steer, about a year old, was inoculated in the right lung, between the seventh and eighth ribs, with some of a culture resembling bovine tubercle bacilli.

No. 628 was a yearling, grade Holstein bull; inoculated into the peritoneal cavity near the right flank with some of a culture resembling bovine tubercle bacilli.

These inoculations were made Saturday, October 18, at the barn near Bussey Institute.

The cultures of the tubercle bacilli used were obtained from the mesenteric lymphatic glands of two children, each about two years of age, who died in the hospital. Cultures from one gland resembled the human variety of tubercle bacilli, the other resembled the bovine variety. The nature of the disease pointed to infection through food, more particularly milk. No. 696, a steer, was killed November 25, as he was evidently badly tuberculous, and it did not seem necessary to keep him longer. The other three animals were killed the middle of December: the autopsies showed the disease in the animals inoculated with the germ of apparently bovine origin to be much more virulent than the others. The experiments are not yet completed, but evidence already accumulated is strongly in favor of the bovine origin of the disease in one of the children.

While the infection of human beings from the use of products from tuberculous animals, more particularly milk, may not be very frequent, yet it undoubtedly does occa-

sionally occur; and cattle which are badly emaciated and extensively diseased, or those with tuberculous udders, are certainly animals which are unfit to furnish a public milk supply.

Recently some experiments have been conducted by Dr. Leonard Pearson, State veterinarian of Pennsylvania, and Dr. S. H. Gilliland, assistant bacteriologist of the State Live Stock Sanitary Board of Pennsylvania, upon the immunization of cattle against tuberculosis. If some method can be devised which will successfully immunize cattle against this disease, it will be of very great value to the live stock interests of this country; but until these experiments are carried out on a larger scale, it is too soon to express an opinion as to how valuable the results will prove to be.

Actinomycosis.

During the year three cows were quarantined as having actinomycosis. One of these was killed, and two released. In addition, two or three cows have been killed which had tuberculosis, and whose udders were supposed to be tuberculous, but upon examination the lesions in the udder were found to be produced by the actinomyces. Actinomycosis of the udder gives it a nodulated feeling, which it is almost impossible to tell from tuberculosis, and in many cases cannot be determined without examination of specimens secured post mortem. Judging from the experiment conducted by the Cattle Commission, an account of which appears in the last annual report of the commission, it does not appear that milk from cows with actinomycosis of the udder is dangerous; but at the same time, until more is known about it, the use of milk from such animals ought to be prohibited.

Foot and Mouth Disease.

The most unexpected occurrence of the year, and one that has made a great deal of work in a short space of time, has been the outbreak of foot and mouth disease.

Foot and mouth disease is well known on the continent of Europe, and has also caused great ravages among the live stock in England. In the last few years, however, it

has been practically eradicated from England, several years having passed without an outbreak in that country, until a year or so ago, when it was introduced again in some way from the continent; but the damage caused by its last introduction has been limited. In European countries, however, it is a source of great loss to the farmers.

In Germany it is known as *Maul und Klauenseuche;* in France, as *fièvre aphtheuse;* in Italy it is known as *afta epizootica;* and in England, besides being spoken of as foot and mouth disease, it is also known as epizootic aphtha.

It is a disease peculiar to cloven-footed domestic animals, the ox, sheep, goat and swine; but very rarely may be communicated by them to the horse, dog and cat, and it is said even occasionally to poultry, and also to man. It occurs also among wild ruminants, such as deer, buffalo, camel, giraffe and antelope.

The disease is characterized by a vesicular eruption on the mucous membrane of the mouth and surface and edges of the tongue; it also appears in the interdigital space, and around the top of the foot at the juncture of the hair and horn. The vesicles break, leaving superficial ulcers.

The disease is accompanied in the early stages by fever, which is particularly high just before the eruption of the vesicles appears. It is highly infectious, being disseminated not only by the cohabitation of sick with healthy animals, but also by manure, litter, stable utensils, clothing and boots of attendants and veterinary surgeons, and also by cattle cars. Even driving healthy cattle over roads previously traversed by cattle suffering from the disease may be sufficient to produce it in the susceptible animals.

Milch cows suffering from foot and mouth disease also have a vesicular eruption upon the udder and teats, and in such cases the milk becomes a medium of infection. After two or three days, the epithelium, which is raised by the vesicles on the udder or teat, peels off. It may peel so as to leave the entire teat raw, making it difficult to milk the animal, and also leading to an extension of the inflammation to the inside of the teat and to the udder, ruining one or more quarters. This complication seems to have been quite frequent during the recent outbreak.

The foot and mouth disease has undoubtedly existed for centuries, — probably for the last two thousand years. It seems to be a native of western Asia and eastern Europe, and has long been known in India and upon the steppes of Russia. As commerce between civilized nations increased and means of communication developed, it spread over Europe from the east to the west, until now it prevails from the Caspian Sea to the Atlantic Ocean. It also exists in India, Ceylon, Burmah and the Straits Settlements. With the development of literature its description became more accurate, and accounts of its spread over Europe in the seventeenth and eighteenth centuries show it to have prevailed extensively in Italy, Germany and France. Toward the end of the eighteenth and early in the nineteenth century it reached western Europe, but did not gain access into England until 1839, and was not known in Denmark until 1841.

Foot and mouth disease seems to be a native of localities in eastern Europe or western Asia, and an exotic in some other countries. For example, it was imported into Canada in 1870, being introduced by two Shorthorn cows brought from Liverpool, and appeared in localities in New York State and some of the New England States; but it does not seem to have assumed a severe form, and in a few months entirely disappeared. Its behavior in thus disappearing may be partly due to its having been introduced in the autumn, and, as cattle in the north are housed during the winter months, there is very little communication between herds; but it may also in part be due to its exotic character. The last outbreak in the United States was in the early '80's (about 1884), when some cattle imported from England were landed at Portland, Me., and driven to the United States quarantine station a short distance away. Soon after a yoke of oxen was driven over the same road, which later developed foot and mouth disease, — the imported cattle having it when landed, — and gave it to the owner's herd; but the disease was soon suppressed, and there has been no reappearance of it until the past autumn.

The United States Bureau of Animal Industry, of the Department of Agriculture, spares no pains to protect the

live stock interests of the country from contagious animal diseases; hence it is unlikely that this malady will ever secure a foothold here, owing to the stringent quarantine regulations imposed by the federal government. Cattle, sheep, other ruminants and swine can be brought into the United States only at points designated by the Department of Agriculture, the ports of entry on the Atlantic seaboard being only at Boston, New York and Baltimore, near which places quarantine stations have been established. All neat cattle are held at these stations for ninety days, and all sheep and swine for fifteen days, after landing. The reason for holding cattle longer is to guard against contagious pleuro-pneumonia; the period for which the sheep and swine are held is sufficient to guard against all danger from foot and mouth disease. Neat cattle also have to be found free from tuberculosis, as determined by the tuberculin test, before being allowed to go beyond the quarantine station limits. Separate gates and lanes are provided for entrance and exit; if, therefore, any contagious disease should make its appearance, there would be no danger of healthy animals becoming infected by being driven over roads where sick animals had previously been.

Importers of animals from England and Europe must also obtain permits from the Department of Agriculture, and, furthermore, must have affidavits that animals come from localities free from contagious diseases, and do not pass through infected districts in transit. The collector of the port of entry is notified when the animals arrive, and immediately turns them over to the care of the agent of the Bureau of Animal Industry having charge of the quarantine station.

In countries where foot and mouth disease has prevailed as an epizootic, the losses occasioned by it have been very great to the farmer from a pecuniary stand-point, not that the mortality is very large, as only from one to three per cent of the infected animals die, but owing to the emaciation due to the fever, and the inability to walk about and eat. This loss is especially heavy when cattle or sheep are being fed for the shambles. Animals nearly ready for the butcher

in a few days lose all the flesh that it has taken them months to put on.

Neat cattle have the severest lesions in the mouth, as a rule, and have great difficulty in eating, although lameness may also be present; while among sheep the foot lesions are usually the more severe, and they will not walk about in search of food, but spend most of their time lying down.

The period of development from the time of exposure is short, usually from three to eight days; but it may not appear in rare instances, it is said, for from two to three weeks after exposure.

When there are no complications, such as sloughing of the feet as seen in very severe cases, the disease in cattle, sheep and swine runs a course of from ten to twenty days.

In other animals the symptoms are somewhat the same, viz., vesicles followed by ulcerations either on the feet or in the mouth; but other domestic animals do not seem to be very susceptible. The horse shows lesions in the mouth, but only as a result of licking infected cattle or drinking or eating from buckets or troughs which diseased creatures have used. Dogs, cats and rabbits may have the disease, but it is said to be infrequent, and, in the dog and cat, is the result of their being kept in the stable with infected ruminants or swine, or of their drinking milk from cows with udder lesions.

Foot and mouth disease may occur in the human family. Among adults attendants of cattle, veterinary surgeons, butchers and drovers are most exposed. It may be acquired from diseased animals, and occasionally it is possible for one person to infect another. Among infants it may be caused by drinking uncooked milk from cows having the vesicles of epizootic aphtha on the udder; it is also said that fresh butter, fresh cheese and whey can convey the germs of the disease.

The period of incubation is quite short, especially when conveyed by milk, in which case it is only from twelve to twenty-four hours before symptoms appear.

In infants the disease is not infrequently fatal. The symptoms consist of fever, headache or dizziness, conjunctivitis,

an eruption on the face or around the mouth, and vesicles in the mouth; and among milkers there may be sores on the tips of the fingers, around the finger nails (there may even be sloughing of the nails), or in the spaces between the fingers. When vesicles develop in the pharynx, they cause great difficulty in swallowing: there may also be vomiting and diarrhœa when the infection takes place through milk, and in the case of infants and small children the disease may then end in death. Recovery usually takes place in ten or twelve days. Among animals it is said that one attack secures only temporary immunity from another. Meat from animals suffering with epizootic aphtha has never been found to be infectious.

Etiology. — Foot and mouth disease is undoubtedly a germ disease, — both clinical and experimental evidence indicate this, — but the specific organism which produces it remains to be discovered. There are other diseases which we believe to be due to a microscopic organism of some description, — such, for example, as rabies, small-pox and cow-pox, — in which the organism is so minute or so difficult to stain or cultivate that it has hitherto not been demonstrated, and the bacterium of epizootic aphtha is unquestionably one of this character. Nosotti, Klein, Schottelius and Kurth have studied micro-organisms found in connection with the lesions of foot and mouth disease, but it does not seem that the true specific cause has yet been discovered.

The vitality of the virus is not considered to be usually very great. Walley says that as a rule the danger ceases at the end of thirty days after the recovery of the last animal; but instances are given in which troughs, hay racks and stables have caused fresh outbreaks after the lapse of several months. Therefore, in taking steps for the eradication of the disease, thorough disinfection of stables and utensils, with destruction of all litter and manure, cannot be too strictly enforced.

The post-mortem conditions found in animals suffering from foot and mouth disease — in addition to the lesions in the mouth and around the feet, and eruptions on the udder

previously mentioned — consist of an inflammation of the stomach and intestines, with perhaps erosions of these organs. Especially is this the case in infants, pigs and calves infected by the use of milk from diseased cows.

The medicinal care of foot and mouth disease consists in treating the symptoms, as they occur, by the use of antiseptic washes, and by the application of dusting powders to the ulcerations. The food should be soft, and of an easily digested character. Large flocks of sheep, where it is impossible to attend to each individual case, are sometimes treated, when the foot lesions predominate, by driving the entire flock daily through a long wooden trough containing some antiseptic drying powder.*

My attention was first called to the possible existence of foot and mouth disease in this section on Wednesday, November 12. Mr. Dennen, the agent of the Cattle Bureau in charge of the stock yards at Brighton, came to the office after market on that date, and informed me that Mr. Henry S. Turner, one of the Rhode Island Cattle Commissioners, who lives at Scituate, R. I., told him that he was afraid that they had foot and mouth disease in Rhode Island. He said that the disease was taken down there by a cow that was brought to the Brighton market from Charlton in Worcester County: she was taken from there to Chelsea, and in two or three weeks from Chelsea back to Brighton, and from Brighton she went with others to Cumberland, R. I.; and that the disease had spread to several herds in that locality.

I immediately wrote to Dr. D. E. Salmon, Chief of the Bureau of Animal Industry at Washington, of what I had heard, and told him I would investigate the matter further, and report as soon as I could learn more.

An agent of the Cattle Bureau, Dr. A. W. Draper, happened to be in the office at the time Mr. Dennen told me of Mr. Turner's fears. He was going to Wrentham the next day and to North Attleborough the following day, and I told him to find out what he could when he was down next to the Rhode Island line, and report to me. From Dr.

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* A part of the above is taken from an article written by me recently for the "Reference Hand-book of the Medical Sciences."

Draper's reports of what he was able to hear, on Saturday, November 15, I went to Wrentham, and with the inspector of animals, Dr. Elisha M. Brastow, drove to Cumberland Hill, R. I., and saw a herd of cattle owned by H. H. Sprague. Mr. Sprague informed me that the disease was first brought to his place about the first of October by three cows that came from a neighbor to be slaughtered This neighbor was the man who originally had the diseased cow which came from Brighton. In about ten days after the animals were sent to Mr. Sprague's, his herd of thirty-three cattle developed foot and mouth disease. He also had five pigs which he told me had it. The animals had evidently had it very severely, as it was a month after the first appearance of the disease when I first saw them, and they had not all fully recovered then. I was not positive as to its being foot and mouth disease, and asked where I could see some fresh cases. Mr. Sprague told me of a place in Smithfield, R. I., where the animals had just become infected, and I went home with the intention of going to Smithfield, Monday, November 17; but after my arrival home I was called up by Dr. Edward Knobel, inspector of animals in Dedham, who asked me if we had foot and mouth disease in this country. I told him that we were not supposed to, as the United States was thought to be free of it; but as he was about leaving the telephone I asked him his reason for asking the question. He said, if we did, he thought he had it in a herd of cattle in Dedham. I told him that stranger things had happened, and I would come out there the next day. I drove to Dedham, Sunday afternoon, November 16, accompanied by Dr. Theobald Smith, professor of comparative pathology at Harvard University, whom I invited to go with me. We went to Mr. John K. Burgess's place in Dedham, where we found thirty-eight cows and a bull, all of which had been sick for about a week. The history there was that about three weeks before he bought a cow from a Brighton dealer and kept her about a week. He did not like her, because she did not eat well, and was lame, and returned her to the dealer. In about ten days after return-

ing this cow his cattle were all taken sick. Driving home, I asked Dr. Smith what his opinion was, and he said that if it was not foot and mouth disease he did not see what else it could be; and after discussing the matter, we decided that it was my duty to telegraph Dr. Salmon at Washington at once. I accordingly telegraphed Dr. Salmon on the evening of November 16, saying: "I believe we have foot and mouth disease in Rhode Island and Massachusetts. Come at once, or send representative." The result of the telegram was the appearance, November 19, of Dr. John R. Mohler, one of Dr. Salmon's agents. By that time I began to hear of other herds, and was able to show Dr. Mohler cases in Sharon. Dr. Mohler's reports were evidently disquieting enough to lead to other experts being sent to confirm the diagnosis. On November 25, Dr. Leonard Pearson, State veterinarian of Pennsylvania and dean of the veterinary department of the University of Pennsylvania, appeared; and the following day, November 26, Prof. James Law of Cornell University, Ithaca, N. Y., arrived, as special agents of the United States Bureau of Animal Industry.

They saw cases in Dedham, Needham, Chelsea, Revere, Everett and Concord, and were satisfied that the trouble was foot and mouth disease. Dr. Salmon came to Boston, Tuesday, December 2, as the result of their confirmation of the diagnosis, and since then the State and federal authorities have been working in co-operation.

At a conference between the Governor of Massachusetts, the Chief of the Bureau of Animal Industry of the United States Department of Agriculture and the Chief of the Cattle Bureau of the Massachusetts State Board of Agriculture, at the State House, December 4, it was agreed that, if the United States Department of Agriculture would pay 70 per cent of the value of animals that were killed because they were infected with foot and mouth disease, or had been exposed to it, the appraisal to be based on what the animals were worth when in a state of health, and made by an expert in the values of cattle, who was also to be a citizen of Massachusetts, the State would authorize the slaughter

of infected or exposed animals where the public good required it.

On December 5, therefore, at a meeting of the Governor and Council, the following resolutions and order were adopted: —

COMMONWEALTH OF MASSACHUSETTS,
COUNCIL CHAMBER, Dec. 5, 1902.

Whereas, The foot and mouth disease, declared to be a contagious disease by the laws of this Commonwealth, exists to an alarming degree among the cattle, sheep and swine of the Commonwealth; and,

Whereas, In the opinion of the Chief of the Cattle Bureau of the State Board of Agriculture, the public good requires the destruction of certain cattle, sheep and swine which have been exposed to said contagious disease; and,

Whereas, The Chief of the Bureau of Animal Industry of the United States Department of Agriculture, by authority of the Secretary of Agriculture, has agreed to reimburse the owners of animals destroyed in accordance with law by payment to the owners of 70 per cent of the appraised value of such animals, such appraisal to be made by an expert in the value of cattle, who shall be a citizen of the Commonwealth, and appointed by said Chief of the United States Bureau of Animal Industry, and to be based upon the value of such animals when in a state of health;

Now, Therefore, It is hereby ordered that the following order of the Chief of the Cattle Bureau of the State Board of Agriculture be approved.

Adopted in Council, Dec. 5, 1902.
E. F. HAMLIN,
Executive Secretary.

BOSTON, Dec. 5, 1902.

To All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease, and is so recognized by the laws of this Commonwealth, exists among cattle, sheep and swine in some sections of this State.

You are hereby further notified that, in order to prevent the spread of this disease, this Bureau has issued the following order: —

It is hereby ordered that all cattle, sheep or swine which have foot and mouth disease, or which have been exposed to it, shall be

killed, in those cases where, in the opinion of the Chief of the Cattle Bureau, the public interests require it.

This order shall take effect upon its approval by the Governor and Council.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Dec. 5, 1902.
E. F. HAMLIN,
Executive Secretary.

Agents of the United States Bureau of Animal Industry were appointed as agents of the Cattle Bureau of the Massachusetts State Board of Agriculture, in order to give them the necessary authority to carry out measures required for stamping out the disease.

The slaughter of diseased and exposed animals for stamping out foot and mouth disease is an unusually radical way of dealing with this malady, and the only excuse for it is on account of the financial and commercial interests involved. The United States Secretary of Agriculture issued an order December 27, forbidding the export of cattle, sheep, other ruminants or swine from the port of Boston until further orders. As large numbers of cattle and sheep were shipped from this port, the loss to the railroad and steamship companies has been very heavy. It is estimated that it has cost Boston $100,000 a day in loss of business. Furthermore, the presence of the disease in New England is a menace to the live stock interests of the country, in case it should spread to other States; and for this reason more vigorous measures have been adopted for its eradication than would otherwise be warranted.

It is not usually a fatal disease; very many animals recover, and are restored to their original value. If the premises where the diseased animals are can be kept under quarantine until the last case recovers, and the buildings and materials contained in them have been thoroughly disinfected, that usually seems to be sufficient to stay the ravages of this plague. But in order to expedite matters, for the sake of allowing New England ports to be opened for the export of animals again, and for the purpose of being able to declare this country free of foot and mouth disease, in

order that Great Britain will allow our animals to be landed at her wharves again, these very radical steps have been taken.

The United States Bureau of Animal Industry disinfects premises where animals are killed; and where they have recovered, and the United States has not yet decided to kill them, the Cattle Bureau of the State Board of Agriculture disinfects the premises.

Immediately upon ascertaining the presence of foot and mouth disease in the community, the following letter was sent to every inspector of animals in Massachusetts: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Nov. 17, 1902.

To the Inspector of Animals.

DEAR SIR: — A disease similar to foot and mouth disease has been lately called to my attention. In fact, the symptoms are so much like those of foot and mouth disease I think it will very likely turn out to be that malady. The cattle are first noticed to drool, then have blisters appear in the mouth or on the tongue, which later break, forming little ulcerating sores. They do not eat well while their mouths are sore. They also have blisters appear around the feet, especially in the space between the two divisions of the hoof, and in some instances blisters appear on the udder, which afterward break and form raw sores on the udders or teats.

The disease may also be communicated to sheep and swine. I wish, if you meet any cases of this kind, you would quarantine the cattle, sheep or swine that have the disease or that have been exposed to it, forbidding the owner to take them off his premises or to drive them across or on the public highway. If his fields have not any public highway between the barn and the lots he wishes to turn them into, he can turn them out if he wishes, provided they do not come in contact with his neighbors' cattle; otherwise, they are to be kept in the stable.

When you quarantine any such animals, you can call the disease, on your quarantine notice, "foot and mouth disease," giving the owner the original copy of quarantine notice, and sending duplicate here. As this trouble may prove to be serious and important, I wish you to give it your careful attention, and carry out any orders directed to you in connection with it faithfully. It may also be conveyed by the shoes, and sometimes by the clothing. I

think, if you have any herds where the trouble exists to deal with, you better wear rubbers and an old waterproof coat that can afterward be sponged off with some disinfectant solution before going among other cattle.

Yours truly, AUSTIN PETERS,
Chief of Cattle Bureau.

In addition to these letters, inspectors of animals in towns adjoining the Rhode Island line had the following letter sent to them, in order to stop as far as possible the moving of cattle from Rhode Island into Massachusetts: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Nov. 18, 1902.

DEAR SIR: — I think that the rules and regulations concerning bringing cattle into Massachusetts have not been observed very well lately, and I wish to call your attention to the fact that persons bringing cattle into Massachusetts must have a permit, and that the cattle must be tested with tuberculin at their expense and risk, except calves under six months old or beeves for immediate slaughter, by a veterinarian satisfactory to me. I recognize the fact that a good many cattle brought in from Rhode Island are cattle that have been sold through the Brighton market, and that, as cattle from Brighton, from out of the State, are tested at the Brighton yards, of course no further test is necessary.

I write just now as I consider this is a particularly important matter, as I am informed that there appears to be a disease among cattle in Cumberland, R. I., which appears to be of a contagious character, the cattle having sore mouths, sore feet and sores on the udders; and I wish the inspectors of animals in the bordering towns to keep a lookout for cattle coming in from Rhode Island, and if any cattle are brought in from without the State, they are to quarantine them and send duplicates to me. Or, if any cattle present symptoms of sore mouths, sore feet, or have any sores on the udders, they are not only to quarantine them, but to quarantine the herd of the person buying any such animals, until I can investigate the matter and see that there is no danger of the spread of the disease.

If you quarantine any cattle, sheep or swine, you can make the notice of quarantine read "foot and mouth disease."

Yours truly, AUSTIN PETERS,
Chief of Cattle Bureau.

Beside sending a letter to the inspectors of animals, calling their attention to the existence of the disease, a letter was immediately sent to the Cattle Commissioners, or State Veterinarians, in all adjoining States except Rhode Island, notifying them that a disease existed in Massachusetts, the symptoms of which resembled foot and mouth disease; and, as it appeared to be very contagious, they were advised to refuse all applications for permits from persons wishing to ship cattle from Massachusetts into their States. This practically gave every adjoining State an opportunity to quarantine against Massachusetts. No notification was sent to the Rhode Island Cattle Commission, as it was evident that there was as much reason to consider Rhode Island infected as Massachusetts.

The following order was approved by the Governor and Council, which acted as a quarantine against all neat cattle, sheep or swine in Rhode Island: —

Nov. 18, 1902.

To Transportation Companies, and All Others whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, it is hereby ordered that no neat cattle, sheep or swine be brought into Massachusetts from the State of Rhode Island until further notice, because of the prevalence of a disorder among cattle of an apparently contagious character in the vicinity of Cumberland, R. I., which resembles foot and mouth disease.

Inspectors of animals in the cities and towns bordering on the Rhode Island line will see that this order is enforced.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Nov. 19, 1902.
E. F. HAMLIN,
Executive Secretary.

As the situation seemed more threatening, on November 26 an order was adopted by the Governor and Council, stopping the market held at Brighton every week until further notice. This order is still held in force: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Nov. 26, 1902.

To the Brighton Stock Yards Company, and All Others whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease, and is so recognized under the laws of this Commonwealth, exists among cattle, sheep and swine in some sections of this State, and also in certain localities in Rhode Island.

You are hereby further notified that, in order to prevent the spread of this disease, this Bureau has issued the following order, to continue until the public safety will allow of its being revoked by the Chief of the Cattle Bureau, with the sanction of the Governor and Executive Council: —

1. The public market for milch cows, working oxen, store cattle, store sheep or store swine, held at Brighton each week, is hereby ordered to be discontinued. Beef cattle, sheep or swine, under control of the United States Bureau of Animal Industry, Department of Agriculture, intended for export, are not included in this order. Beef cattle, sheep, swine or veal calves, except animals from Rhode Island, may be shipped to the stock yards at Brighton, Watertown or Somerville, provided they are for immediate slaughter.

2. Transportation companies bringing cattle, sheep or swine into Massachusetts for the stock yards at Brighton, Watertown and Somerville, are hereby ordered not to accept shipments of milch cows, working oxen or store cattle, or store sheep or store pigs, for these yards; and are further reminded that no neat cattle are to be received for shipment to other points unless accompanied by the usual permit required under the order of April 23, 1902. The order of Nov. 19, 1902, forbids transportation companies to receive any neat cattle, sheep or swine from the State of Rhode Island.

3. Transportation companies are also to clean all manure and litter from cars used in local animal transportation after unloading neat cattle, sheep or swine, depositing it where it will not come in contact with neat cattle, sheep or swine; and, after thoroughly scraping out the car, it must be washed on the floor and sides with a four per cent solution of chloride of lime.

4. Any person violating the provisions of this order will be

punished as provided in section 29 of chapter 90 of the Revised Laws.

This order shall take effect upon the day following its approval by the Governor and Council.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Nov. 26, 1902.
E. F. HAMLIN,
Executive Secretary.

December 1, a special meeting of the Governor and Council was held, giving the Chief of the Cattle Bureau still further power to cope with the disease: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Dec. 1, 1902.

To All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease, and is so recognized by the laws of the Commonwealth, exists to an alarming extent among cattle, sheep and swine in some sections of this State.

You are hereby further notified that, in order to prevent its spread, this Bureau has issued the following order, to continue until revoked by the Chief of the Cattle Bureau: —

1. All neat cattle, sheep and swine upon infected premises are to remain in quarantine until such time as the Chief of the Cattle Bureau decides that it is proper to release them; and no neat cattle, sheep or swine are to be brought upon or removed from such premises without his permission, upon any pretext whatsoever. The disposal of the products or manure of such animals, or litter, hay, straw, utensils and all other material, are subject to the orders of the Chief of the Cattle Bureau.

2. All persons having no business upon premises deemed by the Chief of the Cattle Bureau to be infected with foot and mouth disease are hereby forbidden to trespass thereon.

3. No auctions or public sales of neat cattle, sheep or swine shall be held in localities deemed by the Chief of the Cattle Bureau to be infected, without his permission.

4. All persons are forbidden to drive or transport any neat cattle, sheep or swine over the public highway, or to turn the same upon any unfenced land in such city or town wherein the

foot and mouth disease exists, and after notice thereof has been given by the Chief of the Cattle Bureau, without his special permission so to do.

5. All persons are forbidden to tamper with or disfigure any notices posted by order of the Chief of the Cattle Bureau, subject to the penalty of the law.

This order takes effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Dec. 1, 1902.
E. F. HAMLIN,
Executive Secretary.

A great deal of the work for the first two weeks of the outbreak was preliminary to getting matters in shape to co-operate with the United States authorities. Notices of various kinds were printed and sent out, and the necessary steps to be taken became apparent as different phases in connection with the outbreak developed.

The following notice was sent out for the benefit of all interested persons, to be posted in public places and given to interested individuals by the inspectors of animals in infected localities: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE.

NOTICE.

Whereas, A contagious disease of cattle, sheep and swine, known as foot and mouth disease, and recognized as such by the laws of this Commonwealth, has recently made its appearance in certain localities in this State, and has spread to an alarming extent in certain places, the attention of all persons is called to the following provisions of the law: —

Section 11, Chapter 90 of the Revised Laws, and Chapter 116, Acts of 1902.

The board of health of a city or town, any member or agent thereof or any other person who has knowledge of or reason to suspect the existence of any contagious disease among any domestic animals in this Commonwealth, or that any domestic animal is affected with such contagious disease, whether such knowledge is obtained by personal examination or otherwise, shall immediately give notice thereof in writing to the chief of the cattle bureau of the state board of agriculture, or to any of its agents or inspectors. Whoever fails to give such notice shall be punished by a fine not exceeding one hundred dollars.

Foot and mouth disease is characterized by slobbering or drooling, smacking of the lips and lameness. Upon a closer examination, a vesicular eruption will be found inside the lips, on the dental pad, in the mouth, on the tongue, between or around the digits and upon the udder and teats. Later, the tops of the blisters peel off, leaving superficial ulcerating sores.

It is highly contagious, and may be spread by healthy animals walking upon the highways where contaminated creatures have been driven, by the use of stock cars which have not been disinfected, by utensils and by attendants.

All persons are warned against going from infected premises to those where healthy animals are kept.

The milk from diseased cows is unsafe for food for man or cloven-footed animals, unless cooked or properly sterilized.

This malady is a menace to the public health and to commercial prosperity, and all good citizens are requested to co-operate with federal and State authorities in assisting in its eradication, by reporting all cases that come to their knowledge, and by keeping away from infected premises.

AUSTIN PETERS,
Chief of Cattle Bureau.

STATE HOUSE, BOSTON, Dec. 1, 1902.

Following this was another letter of instruction to inspectors, telling them what they were expected to do within the next few days, and calling for a rapid inspection of all the neat cattle, sheep and swine in every city or town east of the Connecticut River. Inspectors of animals of the border towns, between Massachusetts and Rhode Island, Connecticut or Vermont, received cards to be tacked up on trees on the highways inside the Massachusetts line, forbidding moving cattle, sheep, other ruminants or swine across the boundaries of the State in either direction. Placards were also printed and distributed to be tacked on buildings where the disease existed, forbidding the removal of any neat cattle, sheep or swine from the premises, or the introduction of any new animals until the quarantine is officially removed by the Chief of the Cattle Bureau. This placard also forbids trespassing on the quarantined premises, for fear that persons might carry the infection from one place to another upon the hands, clothing or shoes.

Other placards were sent out for inspectors of animals to post, forbidding auction or public sales of neat cattle, sheep, other ruminants or swine in the counties of Essex, Middlesex, Suffolk, Plymouth, Norfolk, Bristol or Worcester, unless the person wishing to hold such sale had a permit from the Chief of the Cattle Bureau.

Placards were also sent out to be tacked up in conspicuous places in towns infected with foot and mouth disease, forbidding all persons to drive or transport any neat cattle, sheep, other ruminants or swine over any public highway in such towns without a permit signed by the Chief of the Cattle Bureau, or his authorized representative: or to turn out any such animals on any unfenced lands until such time as it is declared by the Chief of the Cattle Bureau to be safe for the cattle traffic to be resumed.

All this means a great deal of work; but it can be seen that, after taking all these measures, everything was prepared to proceed with the more active work of eradication.

Within a few days of the discovery of foot and mouth disease in Dedham, quarantines on infected herds commenced to pour in from different directions. As soon as the disease was found in a town, placards already referred to were sent to the inspector of animals to tack up, prohibiting the movement of cloven-footed animals in the public highways, or turning the same upon any unfenced land.

The following is a list of towns declared to be infected which were placarded in this way, giving the dates when the placards were sent to the inspectors of animals: —

Acton,	Dec. 6	Dover,	Dec. 29.
Attleborough,	Dec. 6.	Everett,	Dec. 6.
Andover,	Dec. 6.	Framingham,	Dec. 12.
Arlington,	Dec. 23.	Grafton,	Dec. 10.
Billerica,	Dec. 6	Harvard,	Dec. 6.
Boxborough,	Dec. 6.	Hudson,	Dec. 6.
Bridgewater,	Dec. 6.	Hatfield,	Dec. 23.
Braintree,	Dec. 12.	Lincoln,	Dec. 8.
Concord,	Dec. 6.	Littleton,	Dec. 6.
Chelmsford,	Dec. 6.	Lawrence,	Dec. 23.
Chelsea,	Dec. 6.	Maynard,	Dec. 6.
Carlisle,	Dec. 6.	Marlborough,	Dec. 8.
Dedham,	Dec. 8.	Methuen,	Dec. 6.

Natick,	Dec. 9.	Southborough,	Dec. 6.
Needham,	Dec. 8.	Sharon,	Dec. 8.
North Attleborough,	Dec. 6.	Wayland,	Dec. 6.
North Reading,	Dec. 8.	Weston,	Dec. 6.
North Andover,	Dec. 6.	Westford,	Dec. 6.
Pepperell,	Dec. 6.	Westborough,	Dec. 6.
Quincy,	Dec. 8.	West Bridgewater,	Dec. 8.
Revere,	Dec. 6.	Wellesley,*	Dec. 10.
Stow,	Dec. 6.	Westwood,	Dec. 23.
Sudbury,	Dec. 6.	Watertown,	Dec. 23.

Six green cards, "Auction forbidden," etc., six white cards, posters for buildings infected, etc., and forty yellow cards, towns declared infected, etc., were sent to the inspector of animals in each town.

A great deal of the trouble north-west of Boston has been due to an auction, November 17, at which 100 head of cattle were sold, and wherever they went, foot and mouth disease was carried. This auction scattered it to Barre, Mass., and Chester, Vt., as well as to many of the towns adjoining Acton, where the auction was held.

The towns of North Attleborough and Attleborough were infected by cattle brought across the line from Rhode Island. The appearance of the disease in Methuen and other towns adjoining Lawrence was probably due to cattle taken to Lawrence from the Brighton market. The herds which were infected in Bridgewater, West Bridgewater, Quincy and Braintree received cattle from droves taken from Brighton. How the single herd that had foot and mouth disease in Danvers became contaminated it is very difficult to say, as there is no report of any other cases in that immediate locality. The owner of the cattle is a market gardener, and it is possible he may have taken produce to Chelsea, and, when he came home, used some of the boxes which had been lying around in Chelsea to feed the cows from.

It is a difficult matter to say positively just where the disease came from: but as nearly as can be ascertained, it appeared as long ago as August in the neighborhood in Chelsea known as Prattsville: and, as Chelsea is next to East Boston, where the foreign shipping comes in, it is not

* Recalled, posted later.

unlikely that the infection was brought over on a foreign steamer in hay or in straw used for packing merchandise, and in some way was carried to one of the places in this locality, and other herds nearby were contaminated. As the lines of Chelsea, Revere and Everett converge at this point, cases have been found in all three places, but the owners of the cattle where the disease existed do not live very far apart.

It is said that foot and mouth disease assumes a milder form in summer than in winter, and the herds first infected probably had a form of the disease that was not particularly virulent, and nothing was thought of it. It is very clear that the cow that carried the trouble to Rhode Island went directly from Chelsea to Brighton, and thence to Cumberland. Other cattle from the infected neighborhood found their way later to the Brighton market, until the yards became infected; and in November it was carried in various directions by different animals. The disease was taken to Acton by two or three cows from Brighton, which contaminated the 100 head sold there at auction November 17.

The inspector of animals of Malden is a veterinarian. He was called in a professional capacity the last of August to see a herd of cattle in Revere, which he says showed symptoms of foot and mouth disease; but he supposed that it did not exist in the United States, and thought it was probably something resembling it. He was about to go to Minneapolis to a meeting of the American Veterinary Medical Association, held there the first week in September. Before going he says he telephoned to the inspector of animals in Chelsea, thinking at the time that the herd which he had seen was in Chelsea and not in Revere, and supposed that he had complied with the law requiring any one to report a disease of an apparently contagious character to the local inspector of animals. As the herd happened to be in Revere, the Chelsea inspector was not the man to look after it, and he says that he does not even remember receiving any notification. The Malden veterinarian returned home after the meeting, and never gave the subject a second thought until the outbreak was called to public attention in the morning

newspapers the day after Thanksgiving. It is therefore apparent that foot and mouth disease existed in the locality of Prattsville as far back as the last of August.

As the inspector of animals of Chelsea and Everett is a veterinarian, and the inspector of animals for the town of Revere is also a veterinarian, it seems strange that, when they made the annual inspection of the neat cattle in these towns, which was ordered by the Chief of the Cattle Bureau to commence October 1 and be completed November 15, no suspicious cases were observed by these inspectors; but it is not unlikely that, when they made their rounds, the cases which had been ailing had recovered to such an extent that symptoms of the disease escaped their observation. If the disease had been reported when it first appeared in the neighborhood of Prattsville, it might easily have been held in check there, and a great financial loss saved to the community.*

The following table shows the number of herds quarantined up to December 31, and the disposition made of them: —

Statistics on Foot and Mouth Disease in Massachusetts, Dec. 31, 1902.

[Showing the towns in which the disease has appeared or been suspected, the number of herds and number of animals quarantined, number released, number killed, etc., to date.]

Neat Cattle.

	Quarantined.		Released.		Killed by United States Government.		Appraised Value.	Percentage paid.
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.		
Abington,	1	21	1	21	-	-	-	-
Acton,	11	172	-	-	8	129	$4,625 00	$4,132 50
Andover,	1	47	-	-	-	-	-	-
Arlington,	1	13	-	-	1	13†	-	-
Attleborough,	2	48	-	-	2	47	1,895 00	1,326 50
Auburndale,	-‡	-	-	-	1	1	55 00	38 50

* In fact, the owner of one of the infected herds in Chelsea says that he had the inspector of animals examine his cattle in a professional capacity about the middle of September, at which time the inspector called the disease foot-rot, and did not recognize its character. If the above statement is true, the inspector of animals made a grave error in not reporting it, as he should have done, to the Cattle Bureau at that time.

† Killed as owned by Hayden of Watertown.

‡ Probably included in quarantine in Sudbury. Owner in Auburndale.

Statistics on Foot and Mouth Disease — Continued.

	Quarantined.		Released.		Killed by United States Government.		Appraised Value.	Percentage paid.
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.		
Avon,	1	4	1	4	-	-	-	-
Barre,	2	30	-	-	2	37	$1,530 00	$1,071 00
Belchertown,	1	1	1	1	-	-	-	-
Billerica,	1	46	-	-	1	46	2,415 00	1,690 50
Boston,	2	18	1	8	1	10	525 00	367 50
Boxborough,	2	43	-	-	-	-	-	-
Boxford,	1	6	-	-	-	-	-	-
Braintree,	5	95	3	60	2	36	1,384 00	968 80
Bridgewater,	2	21	-	-	1	19	840 00	588 00
Brockton,	4	84	4	84	-	-	-	-
Burlington,	3	39	-	-	-	-	-	-
Carlisle,	5	64	-	-	4	60	2,665 00	1,865 50
Chelmsford,	2	72	-	-	2	59	2,385 00	1,997 50
Chelsea,	4	27	-	-	-	-	-	-
Cohasset,	1	2	-	-	1	2	-	80 00
Concord,	17	336	2	51	12	275	13,718 50	9,602 95
Danvers,	1	7	-	-	1	7	315 00	220 50
Dedham,	3	64	-	-	3	26	1,198 00	838 60
Dover,	1	24	-	-	-	-	-	-
East Bridgewater,	3	52	3	52	-	-	-	-
Easton,	1	7	1	7	-	-	-	-
Everett,	1	6	-	-	-	-	-	-
Framingham,	2	56	-	-	2	55	2,965 00	2,075 50
Gloucester,	1	1	1	1	-	-	-	-
Grafton,	1	10	-	-	1	10	485 00	339 50
Hanover,	1	14	1	14	-	-	-	-
Harvard,	1	6	-	-	1	5	-	125 00
Hatfield,	1	50	-	-	-	-	-	-
Hingham,	1	17	1	17	-	-	-	-
Lawrence,	1	5	-	-	1	5	260 00	182 00
Leominster,	1	1	-	-	-	-	-	-
Lexington,	1	1	1	1	-	-	-	-
Lincoln,	4	140	1	50	2	96	4,705 00	3,293 50
Littleton,	10	172	1	17	1	30	1,020 00	714 00
Lowell,	1	1	-	-	-	-	-	-
Marlborough,	3	49	-	-	3	48	2,414 00	1,689 80

Statistics on Foot and Mouth Disease — Concluded.

	Quarantined.		Released.		Killed by United States Government.		Appraised Value.	Percentage paid.
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.		
Marshfield, . .	1	5	1	5	-	-	-	-
Methuen, . . .	7	183	-	-	2	25	$1,269 00	$888 30
Middleborough, .	2	14	2	14	-	-	-	-
Milton, . . .	1	2	-	-	-	-	-	-
Natick, . . .	1	16	-	-	1	14	750 00	525 00
Needham, . . .	2	32	-	-	1	29	1,553 00	1,087 10
North Andover, .	2	85	-	-	2	87	3,990 00	2,793 00
North Attleborough,	1	5	-	-	-	-	-	-
Northborough, . .	1	3	1	3	-	-	-	-
North Reading, .	1	25	1	25	-	-	-	-
Pepperell, . . .	3	8	-	-	1	2	55 00	38 50
Quincy, . . .	9	112	6	82	3	31	1,455 00	1,018 50
Randolph, . . .	1	14	1	14	-	-	-	-
Raynham, . . .	1	1	-	-	1	3	125 00	87 50
Revere, . . .	1	32	-	-	-	-	-	-
Saugus, . . .	1	1	1	1	-	-	-	-
Sharon, . . .	2	39	-	-	-	-	-	-
Somerville, . .	2	9	-	-	-	-	-	-
Southborough, . .	5	164	1	1	4	166	8,625 00	6,037 50
Stow, ...	1	31	-	-	1	30	1,343 00	940 10
Sudbury, . . .	3	61	-	-	1	1	50 00	35 00
Taunton, . . .	4	83	3	68	-	-	-	-
Walpole, . . .	1	4	-	-	-	-	-	-
Watertown, . .	2	44	-	-	2	58*	2,785 00	1,974 50
Wayland, . . .	2	29	-	-	1	12	1,029 00	720 30
Wellesley, . .	1	15	1	15	-	-	-	-
Westborough, . .	9	257	1	20	8	215	9,885 00	6,919 50
West Bridgewater, .	6	104	-	-	4	97	4,763 00	3,334 10
Westford, . . .	5	60	1	7	3	52	2,069 00	1,448 30
Weston, . . .	3	72	-	-	2	23	1,422 00	995 40
Westwood, . .	1	85	-	-	-	-	-	-
Weymouth, . .	1	7	1	7	-	-	-	-
Whitman, . . .	3	80	3	80	-	-	-	-
Totals, . .	194	3,554	47	730	90	1,818	$86,567 50	$62,050 25

* This number includes 13 quarantined in Arlington.

In addition, the following animals have been included in the above quarantines, some of which have been affected: —

Swine,	815
Sheep,	122
Goats,	4
Horse,	1
Number of animals quarantined other than neat cattle,	942

One hundred and forty-four swine and 42 sheep are included in the above valuation, the special appraisal not being given.

Summary.

Number neat cattle quarantined,	3,554
Number other animals quarantined,	942
Total,	4,496
Total number cattle released from quarantine as not affected,	730

NOTE. — The two right-hand columns in the above table are subject to some slight changes, as complete returns have not been made. Where the appraised value is not given and the price paid appears in the extreme right-hand column, the cattle were bought outright.

In addition to the expense to the United States government of killing and paying for the diseased animals is the expense to the government of a large number of inspectors detailed on this special work, also the extra cost to the State of Massachusetts for the employment of agents of the Cattle Bureau of the State Board of Agriculture, and the disinfection of buildings, to say nothing of the commercial loss to the port of Boston. Another item of expense to the State will be the quarantine expenses. Section 21, chapter 90 of the Revised Laws, provides as follows: —

SECTION 21. If animals have been quarantined, collected or isolated upon the premises of the owner or of the person in possession of them at the time such quarantine is imposed, the expense thereof shall be paid by such owner or person; but if specific animals have been quarantined or isolated under the provisions of section five or section nineteen for more than ten days upon such premises, as suspected of being affected with a conta-

gious disease, and the owner is forbidden to sell any of the product thereof for food, or if animals have been quarantined, collected or isolated on any premises other than those of such owner or person in possession thereof, the expense of such quarantine shall be paid by the Commonwealth.

The cattle owners will be notified of this provision of the law, and will also be furnished with the necessary blanks upon which to make their claims for the expense of quarantine. These claims will probably be sufficiently heavy to make it necessary for the Legislature to make a special appropriation to meet them, as it is doubtful if enough of the appropriation made for the work of the Cattle Bureau of the State Board of Agriculture during 1902 will be left to meet all the expenses incurred as the result of the outbreak of foot and mouth disease.

Besides the losses and expenses already spoken of, it must not be forgotten that the loss to the owners of the animals which have been killed will not end with the killing of the animals, as barns where the disease has existed will have to be disinfected, and will then have to be kept empty for several weeks before new cattle can be introduced, and none of the forage on these infected premises ought to be removed for some time to come. This means that a number of farmers will, for the next month or two, be entirely deprived of their chief sources of income.

With the stringent measures that have been taken for the suppression of the disease, the prospects are that it will soon be eradicated. It is to be hoped that in the course of a few weeks more it will be practically a thing of the past, although it may be necessary to keep up a system of inspection in some localities and certain restrictions on the movements of cattle for sometime longer than this. As soon as the disease is eradicated, the Brighton market can be reopened and the cattle business resume its former conditions.

At the time of the visit of Dr. Theobald Smith and the Chief of the Cattle Bureau of the State Board of Agriculture to the infected herd in Dedham, November 16, Dr. Smith carried some glass pipettes with him. Serum from a vesicle on a cow's udder was drawn into the pipettes, after pricking

the vesicle with a needle, and the ends sealed in a spirit lamp. These were placed in an ice chest in Dr. Smith's laboratory, where they remained until the following Friday.

Mr. C. A. Dennen, agent of the Cattle Bureau at Brighton, sent two cows over to Bussey Institution which were bought November 19; also two small pigs, six or eight weeks old. The cows were inoculated November 21 by scarifying the gum under the upper lip with a lancet, and rubbing in some of the lymph. One of the pigs was also inoculated in the mouth and between the toes on one fore foot: the other pig was kept to be fed upon the milk of the cows. These cows, after two or three days, developed typical lesions of foot and mouth disease in their mouths; one cow also showed very slight signs between the divisions of the fore foot. Neither cow ever showed any eruptions on the udder. They both had a very mild form of the disease, and in two or three weeks seemed to have fully recovered. December 11 the cows were killed, post mortem only showing cicatrices in the mouths of both, where the ulcers had been. In one there were a few ulcers still unhealed. Unfortunately, the pig that was inoculated died a couple of days later; post mortem made by Dr. Smith showed it to have congestion of the lungs. As the pigs had probably been kept in a warm place, and then put in a cold barn, it is to be supposed the one that died must have taken cold. The other pig was fed the milk from the cows until he was killed, December 11, but never at any time showed symptoms of the disease.

These experiments were undertaken to furnish additional proof, if any was needed, that the cows seen at Dedham were suffering from foot and mouth disease: and when the diagnosis was confirmed by Dr. Pearson and Dr. Law, on their arrival, these experiments were advanced far enough to still further strengthen the diagnosis of foot and mouth disease.

Texas Fever.

At the time of making the report to the State Board of Agriculture, last July, I reported informally that an outbreak of Texas fever had just appeared in Wellesley. This

is the first time that this disease has obtained access to Massachusetts for five years. The infected animals were brought from Michigan by a Mr. Sias of Wellesley. He loaded 20 cows, with 13 young calves, at Midland, Mich., July 5, arriving at Detroit July 6. The train being late, he unloaded the cattle at the stock yards at Detroit for about an hour to water and rest the cows: they were then reloaded, and arrived at the stock yards at Suspension Bridge early in the morning, Monday, July 7. The cattle rested there until midnight Monday, when they were again reloaded, and were not taken from the cars again until they arrived at Wellesley, Wednesday, July 9. July 16 some of them were noticed to be ailing, and July 17 several were sick. Mr. Sias sent for a veterinarian, Dr. Fowle of Needham, who reported the cases to the Cattle Bureau. The matter was investigated, and a diagnosis of Texas fever was made July 19 by Dr. Langdon Frothingham, after examining material brought to him by Dr. M. Bunker, one of the agents of the Cattle Bureau. Out of the lot of 20, 18 died. Before being taken sick, a few of them were sold; 1 went to Dover and 3 to Framingham, all of which died, beside 14 which died at Mr. Sias's place in Wellesley.

The United States Department of Agriculture requires that separate pens at the stock yards shall be used for cattle coming from quarantined districts in the south from those used for northern cattle, and where the railroad company violates these rules and regulations, the owners of cattle have been able to recover damages. In this case the cattle were unloaded twice, and it has not been clearly proved at which place they were infected. The probabilities are that the disease was acquired at the stock yards at Suspension Bridge, as there are only four small pens there, and there seems to have been no arrangement for using different pens for southern cattle than for northern cattle; but as yet it has not been decided what railroad company is responsible, owing to the fact that the cattle were unloaded twice in transit, and it is possible that they might have been infected at either place.

Southern cattle were unloaded at the yards at Suspension

Bridge June 21. These came from Kansas City, and were consigned to A. Davis at the Brighton abattoir. Mr. Davis has informed the Chief of the Cattle Bureau that cattle ticks were found upon these animals consigned to him at the time of slaughter. The time from June 21 to July 7 is rather short for the eggs of old ticks to hatch so that the young ones could infect northern cattle; but this is the only car of which there is a record at the suspension bridge stock yards which contained quarantined cattle, although the records at these yards seem to have been not very carefully kept, and it is possible that there may have been other southern cattle there prior to June 21. As the weather from June 21 to July 7 was the warmest that prevailed at any time during the past summer, it is barely possible that tick eggs might have hatched in the space of time between June 21 and July 7.

In order to infect northern cattle, it is necessary for the mature female tick to drop from an animal from a Texas fever district and lay eggs, and for the eggs to hatch, the young ticks crawling onto the legs of northern cattle and infecting them. The cattle at Mr. Sias's all had cattle ticks on them. When first seen, the ticks were so small that it was difficult to find them, but after a couple of weeks they attained quite a good size. Owing to the care taken to remove and bury the dead animals and disinfect the ground where they laid, and also to quarantine all those found at the places where they were, the outbreak was confined to the original carload. The only cattle that did not die were at Mr. Sias's place at Wellesley; and he was not allowed to sell any from his premises or introduce any new cattle upon them until the weather was cold enough to kill any young ticks, if any were hatched from eggs laid there.

It seems unfortunate that Mr. Sias has not been able to recover from any railroad company for the loss of his cattle, as they must have been infected as the result of violation of the rules of the United States Department of Agriculture; and where a man loses animals through the fault of others, it seems only just that he should have some redress.

Anthrax.

Since the outbreak of anthrax mentioned in the first semi-annual report of this Bureau there have been no other cases. During the summer symptomatic anthrax, more commonly spoken of as blackleg, has occurred in two pastures. One was in August, in the Woodward pasture in Ashby, where the disease has occurred in previous years. One animal only died, which the inspector had buried, after the carcass was covered with quicklime.

The Cattle Bureau offered to provide protective inoculation with the blacklegoids mentioned in the July report. Only one owner cared to avail himself of it, and two animals were given the protective inoculation. No further trouble has occurred in this pasture.

The other outbreak occurred in a pasture in the town of Huntington, where two young animals died in July. Four cows and four yearlings were left, and at the request of the owner the four yearlings were given the protective inoculation. No report has been received of any further fatalities in this pasture. It is in a locality where other young animals are said to have died in previous years. In other places where blackleg formerly occurred, no reports of the disease have been received. This is probably due in a measure to the Cattle Commission having required owners to cremate carcasses of animals found dead wherever it was possible to have this done, and in this way the spread of the disease has been checked. Where the animals were left to lie on the surface, wild animals and birds scattered the remains around, carried the germs of the disease to other pastures, and infected other herds of young cattle. By cremating every carcass found dead all germs are destroyed, and in this way the spread of the disease is checked.

There is a piece of swampy land in Salem, near a tannery, where cattle die if turned upon it in summer. Last autumn a number of animals obtained access to this meadow, and died, either from eating grass or drinking the water in the swamp near the tannery. The owner of the animals lost eleven cows, which died a couple of days after being found

in the meadow and driven back to their pasture. Whether the meadow is infected with some germ disease from the tannery, or whether the animals died as a result of some chemical in the water, has not been ascertained. Water was taken from the swamp near the tannery to the Agricultural College at Amherst by Dr. James B. Paige, and analyzed, but none of the common poisons were found in it. Previous to this year twenty or thirty other cattle must have died in various seasons from obtaining access to this piece of ground, and these fatalities caused in animals which obtained access to this meadow are certainly worthy of further investigation. It is to be hoped that at some future time the cause of these deaths may be ascertained.

Glanders.

During the year from Dec. 15, 1901, to Dec. 15, 1902, a great deal of the work in connection with glanders has been done by Dr. Howard P. Rogers, one of the agents of this Bureau, and this portion of the report has been almost entirely prepared by him.

During the year 1902 the importance of work among the horses was still manifest, as indicated by the number reported and examined, and the number killed, both by the order of this Bureau and by the owners individually. While the number examined is much larger than in any other year, the number killed is eight less than in 1901. The cities continue to give the larger number of cases.

The sources of information continue as during the last three years, and can be divided into three general classes: first, the reports of local inspectors of the towns and cities; second, reports from individuals directly to this office; and third, reports from the rendering establishments.

In the first instance, there seems to be less tendency than formerly on the part of local inspectors to keep suspected horses under their own personal observation. This is manifestly the better way, as, by the use of mallein or the guinea pig test, many cases can be determined much sooner than would be possible by waiting for natural developments to allow of a positive diagnosis on the physical symptoms.

Where individuals report, the cases are largely doubtful and the report is made that other opinions may be had, and thereby relieve not only the owner but the attending veterinarian of all anxiety as speedily as the circumstances will allow.

The reports of the renderers continue to be of great value. They make possible the better disinfection of infected premises by calling the attention of the Cattle Bureau to them, and also lead to the discovery of a number of other cases that may not even be suspected by the owner.

The financial loss continues very large, $60,000 annually being probably not a heavy estimate. There are several individual losses ranging from $1,000 to $2,000 each.

The danger to human beings is still evident, as shown by the death of at least one person during the year, and possibly two. The latter case is worth mentioning, as it may have been a case of glanders. A man having close connection with stable work died with an unknown disease. Glanders in the stable has since been very prevalent, and one or more old chronic cases have been found among the horses. The attending family physician has since expressed the opinion that the man may have died of glanders contracted in the stable.

The greatest danger seems to be in not recognizing the chronic cases. In one instance a man dying from glanders contracted the disease from a horse or horses (three having it in this stable) in which the history and autopsy showed that the disease had been of long standing, while the physical signs were not very marked. In another instance a case of a supposed diseased tooth proved to be a case of glanders. In this stable single cases of glanders had been taken out by the owner, on the advice of his own veterinarian, for two or three years; finally, several developing together caused a more careful examination and test of the whole stable, when the above case was found and the animal killed.

The following list shows the cases or suspected cases of glanders and farcy reported by towns for 1901, compared with those in 1902; it also indicates where the disease has disappeared and where new outbreaks have occurred, and the increase or decrease in various places: —

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Abington,	–	–	–	1	–	–
Acton,	–	–	3	2	3	–
Adams,	2	1	–	–	–	2
Andover,	3	–	4	3	1	–
Arlington,	8	3	10	14	2	–
Ashburnham,	–	–	–	2	–	–
Ashby,	–	3	–	–	–	–
Attleborough,	2	1	–	–	–	2
Auburn,	2	1	6	–	4	–
Avon,	2	–	–	–	–	2
Bernardston,	–	–	1	1	1	–
Barnstable,	1	3	2	–	1	–
Belchertown,	–	–	–	1	–	–
Barre,	–	–	2	–	2	–
Bedford,	–	–	–	1	–	–
Belmont,	1	–	1	–	–	–
Beverly,	1	–	3	–	2	–
Blackstone,	–	–	–	1	–	–
Bolton,	1	–	–	–	–	1
Boston,	197	2	155	–	–	42
Boylston,	1	–	–	–	–	1
Bridgewater,	–	–	–	1	–	–
Bourne,	–	–	1	1	1	–
Brewster,	–	–	1	–	1	–
Brockton,	14	4	18	8	4	–
Brookline,	8	5	6	–	–	2
Buckland,	–	–	–	1	–	–

City or Town.	1901. Killed or died.	1901. Negative.	1902. Killed.	1902. Negative.	Increase.	Decrease.
Burlington, . .	1	–	1	–	–	–
Cambridge, . .	43	5	50	2	7	–
Canton, . . .	3	–	–	–	–	3
Carlisle, . . .	2	–	–	–	–	2
Carver, . . .	2	–	–	–	–	2
Charlemont, . .	–	–	3	–	3	–
Charlton, . . .	–	–	1	1	1	–
Chatham, . . .	1	–	–	–	–	1
Chelmsford, . .	–	1	2	1	2	–
Chelsea, . . .	12	1	12	–	–	–
Cheshire, . . .	–	–	1	–	1	–
Chicopee, . . .	–	3	–	–	–	–
Clinton, . . .	4	1	1	1	–	3
Cohasset, . . .	–	–	1	–	1	–
Concord, . . .	–	–	–	1	–	–
Cummington, . .	–	1	–	–	–	–
Danvers, . . .	4	–	–	–	–	4
Dartmouth, . .	–	1	2	–	2	–
Dedham, . . .	4	1	1	–	–	3
Deerfield, . . .	6	–	–	–	–	6
Dennis, . . .	–	1	1	1	1	–
Dighton, . . .	–	–	1	–	1	–
Dover, . . .	1	–	–	1	–	1
Dracut, . . .	2	–	2	–	–	–
Dunstable, . . .	1	–	–	–	–	1
East Bridgewater, .	3	1	–	–	–	3
Easton, . . .	1	1	2	–	1	–

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Everett,	7	1	8	1	1	–
Fall River,	35	2	43	4	8	–
Fairhaven,	1	1	–	–	–	1
Fitchburg,	5	6	3	2	–	2
Foxborough,	–	1	–	–	–	–
Framingham,	14	5	7	11	–	7
Franklin,	1	–	–	1	–	1
Gloucester,	–	1	1	2	1	–
Grafton,	3	–	1	–	–	2
Greenfield,	–	–	1	–	1	–
Greenwich,	–	–	3	1	3	–
Groveland,	2	2	–	–	–	2
Halifax,	3	–	–	–	–	3
Hanson,	–	–	1	–	1	–
Hanover,	–	2	1	1	1	–
Hardwick,	–	–	2	4	2	–
Haverhill,	6	–	2	1	–	4
Hingham,	2	–	1	–	–	1
Hinsdale,	–	–	–	1	–	–
Holbrook,	2	1	1	1	–	1
Hyde Park,	8	1	3	–	–	5
Ipswich,	–	1	–	–	–	–
Lancaster,	5	–	–	–	–	5
Lawrence,	4	–	35	2	31	–
Leicester,	–	–	1	–	1	–
Leominster,	5	1	1	1	–	4
Lexington,	5	1	4	2	–	1

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Leyden,	–	–	–	1	–	–
Lincoln,	–	–	1	–	1	–
Littleton,	–	–	–	1	–	–
Lowell,	7	2	8	–	1	–
Lunenburg,	–	2	2	–	2	–
Lynn,	13	4	14	1	1	–
Lynnfield,	1	–	2	–	1	–
Malden,	10	–	6	–	–	4
Mansfield,	1	1	1	6	–	–
Marblehead,	1	–	–	–	1	–
Marlborough,	1	1	–	1	–	1
Marshfield,	–	1	–	–	–	–
Medfield,	1	–	–	–	–	1
Medford,	5	–	10	11	5	–
Medway,	1	–	–	–	–	1
Melrose,	7	2	1	–	–	6
Methuen,	–	–	2	6	2	–
Merrimac,	–	–	–	1	–	–
Maynard,	–	–	1	1	1	–
Middleborough,	25	1	2	1	–	23
Milford,	1	2	3	–	2	–
Millbury,	1	1	–	–	–	1
Milton,	3	–	3	1	–	–
Monson,	–	–	1	1	1	–
Montague,	–	–	–	2	–	–
Nahant,	5	1	–	–	–	5
Natick,	8	10	–	–	–	8

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Needham,	11	1	4	1	-	7
New Bedford,	9	-	6	2	-	3
New Salem,	-	-	-	1	-	-
Newbury,	1	-	-	-	-	1
Newburyport,	-	-	5	3	5	-
Newton,	17	2	24	56	7	-
Northbridge,	-	-	2	-	2	-
Northborough,	-	-	2	-	2	-
Northampton,	-	-	3	22	3	-
North Attleborough,	1	-	-	-	-	1
North Andover,	-	-	1	-	1	-
North Reading,	1	-	-	-	-	1
Norwell,	-	-	-	1	-	-
Norwood,	1	1	1	-	-	-
Oxford,	-	-	-	2	-	-
Paxton,	2	-	1	-	-	1
Palmer,	-	-	1	-	1	-
Peabody,	-	-	2	-	2	-
Pembroke,	-	-	-	1	-	-
Pepperell,	1	-	1	1	-	-
Phillipston,	-	-	-	1	-	-
Plainfield,	-	-	-	1	-	-
Pittsfield,	5	-	-	7	-	5
Plymouth,	-	-	-	1	-	-
Prescott,	-	-	-	1	-	-
Princeton,	1	2	-	-	-	1
Quincy,	9	-	8	2	-	1

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Randolph,	3	–	1	–	–	2
Raynham,	–	–	2	1	2	–
Revere,	1	–	5	2	4	–
Rochester,	2	1	1	–	–	1
Rockland,	2	–	4	2	2	–
Salem,	2	1	3	2	1	–
Sandisfield,	–	2	–	–	–	–
Saugus,	3	2	2	2	–	1
Shrewsbury,	1	1	5	–	4	–
Sharon,	–	–	2	–	2	–
Southborough,	–	1	–	–	–	–
Southbridge,	1	–	5	–	4	–
Somerset,	–	1	1	–	1	–
Somerville,	30	9	50	8	20	–
Springfield,	2	–	5	2	3	–
Sterling,	2	10	1	1	–	1
Stoneham,	4	–	–	–	–	4
Stow,	1	–	–	–	–	1
Stoughton,	2	1	1	1	–	1
Sturbridge,	–	–	1	–	1	–
Sudbury,	–	1	2	2	2	–
Sutton,	–	1	–	1	–	–
Swampscott,	–	–	1	–	1	–
Taunton,	–	–	8	–	8	–
Truro,	–	–	–	1	–	–
Wakefield,	4	–	1	–	–	3
Walpole,	t	–	–	–	–	1

CITY OR TOWN.	1901.		1902.		Increase.	Decrease.
	Killed or died.	Negative.	Killed.	Negative.		
Waltham,	5	5	5	30	–	–
Watertown,	7	1	5	1	–	2
Webster,	–	1	–	–	–	–
Wayland,	–	–	1	–	1	–
Westhampton,	–	–	2	–	2	–
West Boylston,	1	–	1	–	–	–
Wareham,	–	–	–	2	–	–
Wellesley,	–	1	–	–	–	–
West Newbury,	1	–	–	–	–	1
West Springfield,	–	1	1	1	1	–
Westborough,	–	1	–	–	–	–
Westminster,	–	2	2	2	2	–
Westport,	2	–	4	2	2	–
Westwood,	1	3	1	–	–	–
Weymouth,	–	–	3	–	3	–
Whitman,	3	–	4	–	1	–
Williamstown,	1	–	–	–	–	1
Winchendon,	3	2	–	–	–	3
Winchester,	3	–	–	–	–	3
Winthrop,	5	–	1	1	–	4
Woburn,	1	1	6	1	5	–
Worcester,	55	13	67	7	12	–
Wrentham,	3	–	–	1	–	3
Yarmouth,	2	1	–	–	–	2
	745	163	737	290	–	–

Forty-nine cases remained undecided, 48 of which are shown in the mallein test table.

In 1902 it will be seen by the above table that, compared with the previous year, there is a decrease of 8 in the actual number of cases killed. The total number of cases on record is 1,027, — an increase over 1901 of 119 cases. A larger number of cases have been investigated that have not been killed than in the previous year; this is chiefly due to the amount of mallein used, a great many horses having been tested in stables where glanders has occurred.

In dealing with glanders, it seems to be much easier to eradicate it in the smaller cities and towns and in the sparsely settled rural districts than in the larger cities and their surroundings. In the former places, the watering troughs are closed, the blacksmiths urged to whitewash their shops, and any diseased horses killed, their stables disinfected and suspicious ones kept under observation. But in larger cities, such as Boston, Worcester and Fall River, it is ever-present, and these places serve as centres of infection, to keep the disease from disappearing entirely in surrounding cities and towns.

In Worcester and Fall River the horses among which glanders is found are largely owned by the foreign population, and are kept in small stables or barns, which are very hard to thoroughly disinfect. The lack of understanding on the part of these owners of the seriousness of the matter is another factor that has to be contended with. As these cases are spread over the entire city, it seems that the watering troughs must have a large share of the blame for the spreading of the disease.

In Taunton there has been an outbreak of small size that is interesting, as showing the probable influence of the public watering troughs.

It was found that a grocer on one side of a square in which there was a public watering fountain had a horse killed shortly before, because it had glanders. On the opposite side was another grocer, with two horses that proved to have glanders. The history of these three grocery horses shows that they had glanders for some weeks, and had been allowed to go to this fountain at will. Six of the 8 horses credited to Taunton (including the grocery horses) and 1

credited to Raynham were in the habit of watering at this fountain constantly.

The most notable instance of decrease, as shown in the above table, is in Boston. Lawrence shows a large increase, 15 of the cases being credited to one stable. Fall River, Newton, Somerville and Worcester show an increase. The increase, and in fact the larger number, in Newton, is credited to one stable. Middleborough, where there was such a widespread outbreak in 1901, had only 2 cases in 1902. Fitchburg, a centre of infection three or four years ago, had only 5 cases in 1901 and 3 in 1902. There have been no positive cases in the Berkshires, with the exception of 1 horse in Cheshire.

Mallein has been used more extensively than ever, with two objects: first, to confirm doubtful physical diagnoses; and second, to enable owners to divide those that react and are considered suspicious from those that do not react and are considered free from disease. The value of mallein used in this way seems satisfactory, both to the Bureau and to most of the owners. While the proof of the value of mallein is not positive, nevertheless, it is evident that the spread of glanders in large stables can be checked, not only by the more careful supervision of suspected cases that is offered, but possibly by the therapeutic action in checking the development of the disease,—a belief advanced by several good observers.

The following table shows in detail, as far as completed, the more important stables in which mallein was used to divide suspected animals from others. In all cases where possible, the reacting horses have been kept in a stable by themselves and worked by themselves.

Original Number in Stable.	Number killed before testing all in Stable.	Number tested with Mallein.	Number reacting or giving Partial Reaction.	Number released on First Test.	Number released on Second Test.	Number released on Third Test.	Number released on Fourth Test.	Number released on Fifth Test.	Total Number released.	Killed on showing some Clinical Evidence.	Number to be tested again.
44	4	40	*10	30	7	-	1	1	37	1	-
9	2	7	-	7	-	-	-	-	7	-	-
17	5	12	9	3	-	-	-	-	8	1	-
8	4	4	2	2	2	-	-	-	4	-	-
4	-	4	4	-	4	-	-	-	4	-	-
3	1	2	-	2	-	-	-	-	2	-	-
9	2	7	5	-	3	2	-	-	6	1	-
†82	4	78	27	‡52	2	-	-	-	54	8	17
33	1	32	§12	20	8	1	-	-	9	2	-
28	3	25	3	22	-	-	-	-	-	1	2
40	13	‖27	6	-	-	-	-	-	-	-	27
7	2	5	1	4	-	-	-	-	4	-	1
284	41	243	79	142	26	3	1	1	135	14	47

The foregoing table shows the number of animals tested with mallein, the number of stables and the disposition made of the animals.

In no instance has a horse been condemned on a mallein test alone. Some physical evidence must be apparent before horses are killed, unless on request of the owner. In one instance a horse was proven to have had glanders, that was released on the first test. The mistake in this case has been accounted for.

The guinea pig test is still used to a large extent in diagnosing doubtful cases. This seems the most satisfactory

* One mule in this lot killed by accident. No autopsy held.

† There have been occasional cases of glanders taken from this stable during the past two or three years.

‡ One horse released on first test afterwards showed clinical symptoms.

§ One horse killed by owner, and no lesions of glanders were found on autopsy. The reaction was not typical.

‖ All the horses in this stable are to be retested, owing to the unsatisfactory temperature chart.

way to make a diagnosis, when it is possible to get some of the discharge from the nose or a sore. If the guinea pigs develop glanders, it is positive proof that the horse is suffering from some form of the disease; and many chronic cases are now killed in the early stages of the malady, that in former times might have been allowed to live for years, spreading the infection among other horses wherever they went.

The value of the reports from the rendering establishments, as required by law, is still apparent. Whenever a report of a case of glanders is received from them that was not previously known, the local inspector of the town or city from which the case came is notified of the fact, and instructed to examine other horses in the stable, and see that the premises are properly disinfected. The cases of glanders and farcy which have been reported to the Cattle Bureau by renderers are given in the subjoined table: —

	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not reported previously.
Springfield Rendering Company, Chicopee,	1	1	–	1	–
Guy N. Barnes Rendering Company, Fall River,	25	41	–	41	4
Bartlett & Holmes, Springfield,	3	3	–	3	1
Butchers' Slaughtering and Melting Association, Brighton,	36	94	10	84	27
W. C. Lawrence, Brockton,	12	20	–	20	1
Lowe Bros. & Co., Fitchburg,	5	5	–	5	1
Lowell Rendering Company, Lowell,	6	6	–	6	2
J. J. Burke, South Sherborn,	3	3	–	3	1
Bard & Wiggins, Haverhill,	3	2	–	2	1
William Higgins,	2	2	–	2	1
James P. Trainor, Auburn,	4	4	–	4	1
Jas. E McGovern, Lawrence,	15	39	–	39	7
McQuade Bros., Auburn,	17	36	–	36	6
Muller Bros., North Cambridge,	34	72	3	69	14
Parmenter & Polsey Fertilizer Company, Peabody,	15	21	–	21	7
N. Ward & Co., Boston,	43	136	107	29	10
E. J. Whitman Rendering Company, Dracut,	3	3	–	3	2
A. K. Silloway, Newburyport,	1	1	–	1	–
Totals,	228	489	120	369	86

The reason for reporting the number of cases in Boston separately is because the Board of Health has full jurisdiction over glanders and farcy, and this Bureau has nothing to do with investigating cases which occur in Boston.

The law provides a penalty for any one removing, transporting or selling an animal with a contagious disease, if the person knows or has reasonable cause to believe such to be the fact. Persons disposing of glandered horses always deny that they knew or suspected the existence of a contagious disease, and it is therefore useless to prosecute cases unless proof is forthcoming to show there was good reason for believing the presence of glanders and farcy. But one case occurred in 1902 where the Cattle Commission prosecuted a man for disposing of a glandered horse. This occurred near Greenfield, and a conviction was secured.

Contagious Diseases of Swine.

Between Dec. 15, 1901, and Dec. 15, 1902, 18 outbreaks of diseases of an apparently contagious character in swine have been reported in Haverhill, Sharon, Easton, Ludlow, Lancaster, Greenfield, Boston, Worcester, Townsend, Chatham, Halifax, Erving, Florida, South Hadley, Weston, Springfield, Great Barrington and Orange. On investigation, most of the diseases have been found to be either hog cholera or swine plague. About 900 swine have been involved, and of these, about 300 have died.

Where contagious disease appears among a lot of swine, about all that can be done is to quarantine the premises, and not allow the owner to sell any until the sick have either died or recovered, and no more cases appear. Owing to farmers, as a rule in this section, keeping their pigs confined in pens, diseases of swine do not seem to spread to the extent that they do in the west, and the outbreak is usually of a limited character. In very many instances it is undoubtedly aggravated by the conditions under which the animals are kept, being confined in dirty pens, and fed on city swill or swill from hotels. A number of the cases reported during the past season have been among swine which were fed upon swill from hotels, and the animals that were sick have recov-

ered, and no more cases have appeared when they were put in clean pens on fresh ground and the food changed. Undoubtedly much of the sickness among swine can be prevented by paying more attention to keeping them clean and feeding them carefully. Where swill is fed, cooking prevents disease by destroying the germs in it.

Diseases of Sheep and Goats.

During the winter and spring sickness was reported in two flocks of Angora goats and two flocks of sheep. The flocks of goats were in Bedford, and on an island near Chatham off Cape Cod. The flocks of sheep which seemed to have trouble are in Grafton and Granby.

Investigations of the sickness in the flocks of sheep by Dr. Paige at the Agricultural College showed them to be suffering from parasitic infection; the nodular disease due to the *œsophagostoma columbianum* was present, but it is doubtful if this disease caused the fatalities. In the fourth, or true stomach, of the infected sheep, large numbers of round worms (*strongylus contortus*) were found; and in the flock of sheep at Grafton another form of round worm was found in the small intestine (*cernuus dochmius*). It is thought that the round worms were sufficient in number to interfere with the processes of digestion, and cause the death of quite a number of sheep. The flock in Granby numbered 18, and all have died; and the one in Grafton was reduced from a flock of nearly 100 to 27 or 28.

Bulletin No. 35, of the Bureau of Animal Industry of the United States Department of Agriculture, refers to some of these parasites of sheep, and the treatment. The owners of these two flocks have been advised to write for this bulletin, and follow the recommendations made in it.

A request was also made to this office to investigate sickness in the two flocks of goats mentioned above; but no cases of disease have occurred since then where post-mortem specimens could be obtained for examination.

Rabies.

In the first semiannual report of the Chief of the Cattle Bureau, last July, it was said that cases of rabies had been of very infrequent occurrence in Massachusetts for the last two or three years. But two authentic cases have occurred during the year. One, mentioned in the previous report, was that of the bull terrier owned in Chelmsford, which bit a St. Bernard dog and two horses, the property of his owner. After biting them he was killed, and the head was sent to Dr. Frothingham at the Harvard Medical School for examination. On experiment, all animals inoculated died with rabies. The other dog and two horses were kept under observation for ninety days from the time they were bitten, and they were then released from quarantine, never having shown any symptoms of the disease.

June 3, the head of a dog, supposed to have rabies, was sent in by Dr. E. A. Madden of Watertown, but the rabbits inoculated did not develop the disease.

August 5, the body of a Boston terrier was sent from Lynn. The owner was anxious, as the dog had appeared to be ill-tempered for a number of days, and had bitten two young ladies, one just before he was sent to the Medical School, and the other two or three weeks before. Rabbits inoculated with the material from his brain remained healthy; the dog, therefore, was free from rabies.

August 22, Dr. J. R. McLaughlin, inspector of animals of Newton, sent the head of a dog to the Medical School to be tested to see whether it had rabies or not, but the results were negative.

About December 20, a stray dog was shot in Pittsfield by a Mr. Hay, a butcher, and the head was sent to the Medical School by Dr. G. N. Kinnell, the inspector of animals at Pittsfield. Two rabbits, inoculated subdurally by Dr. Frothingham, developed rabies December 31. This animal was an ownerless dog; no one knows from whence he came; but as they had an outbreak of rabies two or three years ago in New York State, between Pittsfield and Albany, it is possible

that he may have strayed into Massachusetts from New York State. He snapped at two or three people, but there is no record of his having broken the skin on any of them. He also bit a horse, but it is doubtful whether he abraded the skin enough in this instance to infect him. The inspector at Pittsfield has been written to, to be on the alert, and if he hears of any dogs in the neighborhood that may have been bitten by this animal, to quarantine them. He has also taken pains to inform the people in the locality to be on the lookout for any suspicious animals. It is to be hoped that this case of rabies will not lead to any further developments.

The laboratory work, such as inoculating guinea pigs with material from horses suspected of having glanders and farcy, and the examination of pathological specimens collected to determine the nature of disease, has been conducted, as usual, by Dr. Langdon Frothingham at the Harvard Medical School. Dr. James B. Paige has also investigated some cases for the Bureau at the veterinary building at the Agricultural College, Amherst. In addition to this are the experiments made by Dr. Smith at Bussey Institute. I wish here to express my appreciation of the assistance and courtesy extended to me by these three gentlemen.

In concluding this report, the following recommendations are made: —

First. — That an appropriation be made of $100,000 for use of the Cattle Bureau for the ensuing year, as early as possible in the legislative session, in order to meet any expenses that may be incurred. It seems necessary to have more than last year, because there may be extra expense in connection with foot and mouth disease. There should be enough also to carry on the regular work of the Cattle Bureau; and, if more money is appropriated than usual, it will be possible to do more herd testing for owners who wish to eradicate tuberculosis from their herds.

Second. — It may be necessary to ask for a deficiency appropriation to settle claims against the State for quarantine expenses in connection with foot and mouth disease.

Third. — It may be necessary to ask the Legislature for an additional appropriation to reimburse cattle owners the other 30 per cent in cases where animals were destroyed to check the spread of foot and mouth disease, as the United States government paid but 70 per cent of the appraised value.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

BULLETINS

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MASSACHUSETTS CROP REPORTS, 1902.

GREENHOUSE CONSTRUCTION AND MANAGEMENT.

BY PROF. S. T. MAYNARD, FORMERLY PROFESSOR OF HORTICULTURE AT THE MASSACHUSETTS AGRICULTURAL COLLEGE.

The increased demand for vegetables out of their natural season and cut flowers during the winter months has resulted in the building of glass structures for their growth in almost every city and large town in New England. Vegetable growing under glass and growing cut flowers are industries that can well be carried on in connection with many other lines of agriculture and horticulture, as they furnish employment during the winter months, when there is little that can be profitably done out of doors; and in many country towns we find examples of successful and profitable enterprises in growing lettuce, cucumbers, tomatoes, carnations, roses, etc.

At first thought it seems as if this success came to the young men who undertake such enterprises without much effort, and at the first trial; but when we investigate more fully we find many failures before success crowned their efforts, and we learn that the details of the business can only be mastered so as to insure success in the same way as is required in any other kind of business, *i.e.*, by continued practice. Many failures are often made before one succeeds, and yet any young man or woman with a love for plants and flowers who will make a careful study of the work as it is conducted by the successful greenhouse men, of whom there are so many examples in Massachusetts, with a little capital and a determination to succeed, will have no serious difficulty in mastering the business in two or three years. They will find, however, that they will be able to learn something each year if they continue in the business, even for a lifetime.

For success, some of the conditions that must be provided are as follows: —

Location. — Glass houses should be located where the greatest amount of sunshine shall be obtained during the months of December and January, and be as much sheltered from the north and north-west winds as possible.

Drainage. — It is very important that the most perfect drainage be obtained; that there be no standing water in any part of the house or near the surface of the ground inside; that water used or coming into the house shall drain away quickly. Surface drainage should be provided by surface and under drains about the building, so that during heavy rain storms the surface water shall run away from the building, and not toward or into it.

Water. — Water supply, with a head of at least forty feet, is a necessity for the best results. This should come from cisterns or reservoir, and not from wells.

Construction.

Greenhouses can often be built in the country cheaper than in the city, as materials like lumber, stone, etc., can often be obtained at a less cost than in the city, and if the owner is at all skilled in the use of wood-working tools, he can do much of the work upon the common greenhouse structure.

Kinds of Greenhouses.

The form of greenhouse to be built must depend somewhat upon the location and the kind of crop to be grown, though the modern greenhouses of all forms are so constructed, with light sash bars and large glass, as to provide ample light, and success with any of them depends more upon the amount of heat supplied and the skill of the grower than anything else. Most of the modern houses for all kinds of crops under glass are lean-to or three-quarters-span houses, facing the south, south-east or south-west, though some very good even-span rose houses are built that give very good results.

The simplest structure that would have much value for commercial purposes is the lean-to house (Fig. 1). This

may be attached to the south side of a stable or dwelling-house, and, being sheltered from the north, requires only comparatively little heat, but, on the other hand, cannot be as well ventilated as a house exposed on all sides.

The three-quarters-span house (Fig. 2), facing the south, is the one most used by commercial florists and market gardeners. It possesses the advantage of being cheap in construction, affording the greatest amount of sunshine, and may be ventilated from all sides when necessary, for growing crops require low temperature and an abundance of light.

The foundation of these houses may be of stone or cement, or the walls may be built upon chestnut posts set deep in the ground, or cast-iron posts made for this purpose. The north wall is made of non-conducting material, while the south wall is of glass.

The even-span house (Fig. 3) is generally placed north and south, and has the advantage of exposing the plants to sunlight upon all sides, and receiving the greatest amount of sun's heat and light in the morning and afternoon. This is much used for the growth of roses, chrysanthemums, etc.

The side-hill house (Fig. 4) possesses some advantages over those already mentioned. When built on a south, south-east or south-west slope, they are perfectly protected on the north, and susceptible of perfect drainage, no matter what the nature of the soil. The cost of the side walls and the terrace walls (Fig. 4, *a*) is much less than that of outside walls and beds or benches in the other forms of houses. It is practically a *one*-roofed house with no gutters. One objection to this form may be found in the effort required in going up and down from one part of the house to the other.

Materials.

The best wood for greenhouses is cypress or clear-heart white pine, the former being generally considered the best, because of its straight grain and the great length, but it is more liable to warp out of place unless firmly nailed when put in place.

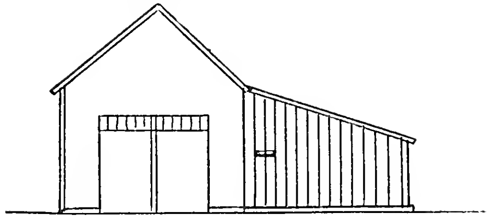

FIG. 1

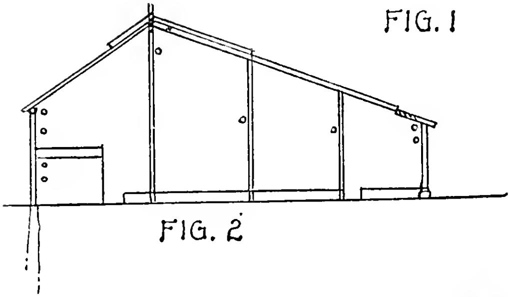

FIG. 2

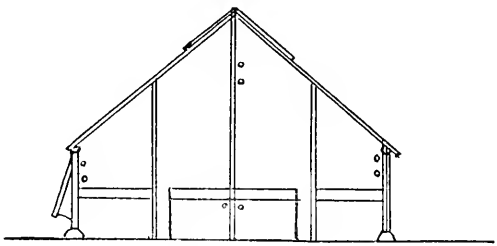

FIG. 3

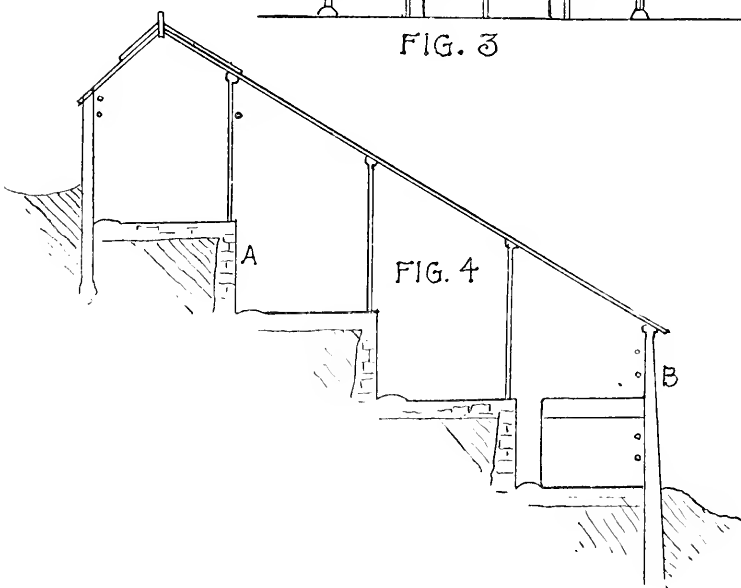

FIG. 4

Foundation.

A good foundation must be provided, or a house will often settle out of shape, and such light structures are easily ruined by this settling. Stone, concrete, brick, iron and wood may be used for foundations. Stone foundations should be put in below the reach of frost, and be well laid in mortar containing one-fifth Portland cement. Concrete can be made by digging a trench from eight inches to one foot wide, and tamping in a rather dry mixture of Portland cement, one part to five of sand and small stone. The parts above the surface must be held in place by planks, and be put in moist enough to be poured in from a pail. When nearly set, a skim coat of cement and sand, one to three parts, may be used to dress up the surface. If good cement is used and is properly mixed, a permanent and neat foundation wall can be made.

Stone foundations are more generally used with brick to top them out with, but to be satisfactory the brick must be laid in cement mortar. Many good houses are built by sinking chestnut or cedar posts three and one-half or four feet below the surface, and standing above the surface high enough to form the walls upon. The north walls of the three-quarters-span house may be thus formed by having the posts stand five to six feet out of the ground, while the front walls may be three to five feet high, according to the use for which the house is designed. All the posts should be faced on both sides from the point where they come out of the ground to an even thickness at the top (Fig. 4, *b*), so that the wall may be the same thickness. Cast-iron posts are used in many modern houses, being sunken below the surface as deeply as wooden posts, and the main framework bolted to them. These are most largely used when the main rafters and perlins are also of iron.

Superstructure.

Sills. — These should be of cypress or chestnut, the first being preferred; but in case of a home supply of the latter, it will be the much cheaper material and nearly as good. In

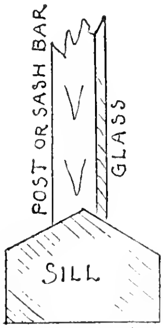

FIG. 5

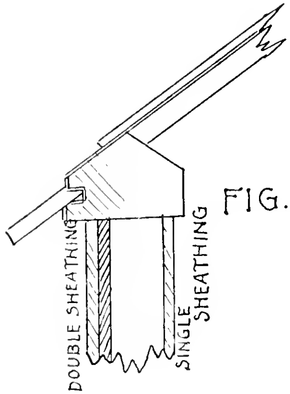

FIG. 8

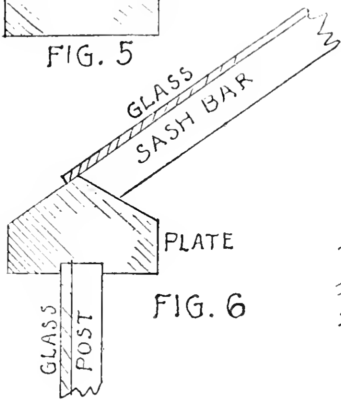

FIG. 6

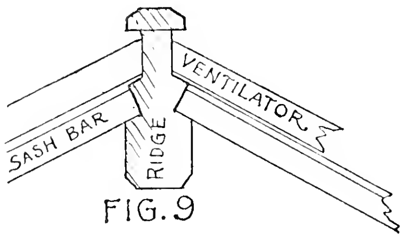

FIG. 9

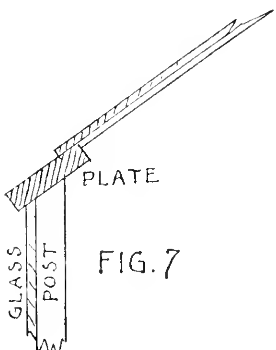

FIG. 7

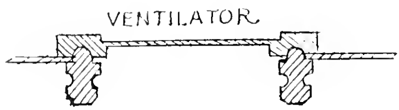

FIG. 10

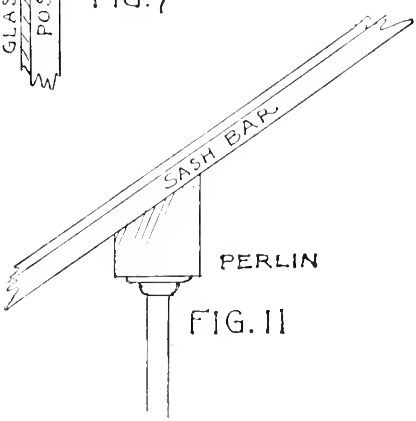

FIG. 11

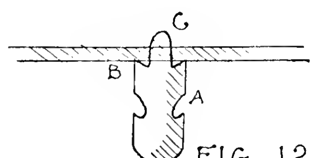

FIG. 12

form the upper side should be sloped so that the water will run off quickly, as in Fig. 5, as with water standing continually on the surface they will rot out very quickly, no matter what the material may be.

Posts. — The modern glass structures for growing plants are made of such light material that few posts, except those for the corner, the door posts and ventilator frames, are used, the main part of the structure being supported by light gas pipe three-quarters to one and one-half inches in diameter, as in Figs. 2, 3 and 4. In some cases iron frames are used when the structure is very light, consisting only of the frame and gas-pipe supports, the sash bars and other woodwork resting as a shell upon the iron supports.

Sash Bars. — The form of sash bars most in use is shown in Fig. 12, having drip gutters at *a*, to catch the drip as it runs down the glass and carry it to the plates and walls of the house. Upright sash bars should be made without this drip gutter. The sash bars are supported by perlins (Fig. 11), which in turn are supported by gas pipe or light lumber.

Perlins. — In many cases angle iron is used as perlins, which is much more expensive, but more durable.

The ridge (Fig. 9) may be a plain board, six to eight inches wide, or, better, one formed out of two-inch lumber, with a groove cut for the support of the sash bars and ventilators.

Plates (Figs. 6 and 7) are made in many forms, but, as with the sills, should always have a sloping top to carry away the water quickly. Fig. 7 represents a very good plate, consisting of a two-inch plank eight to ten inches wide, spiked on the top of the posts or frame, the sash bars being fastened to the upper edge. To avoid shade from the plate on the south side of the house, some houses are built by having the upright sash bars meet those of the roof and wall, the upper range of glass shutting over the lower, so that the water will run away from the front wall. When iron frames are used, the front wall may be out of perpendicular from four to six inches to aid in this discharge of the drip. Another means of carrying the drip away from

the front wall is obtained by inserting into the plate of ordinary form a "drip board" six to eight inches wide, as in Fig. 8.

Ventilators. — These should be placed about the houses in such a way as to give the proper amount of air for the crop grown, and be used for this purpose alone, and not to regulate the temperature. The skilful fireman will so regulate his fires as to require but little movement of the ventilator to keep up the even degree of heat required.

For forcing roses and other plants requiring a high temperature, and that are easily injured by a draught of cold air, the ventilators should be placed only on the south side, and be hinged so as to open at the top, that the cold air may enter at the highest point and become warm before it comes in contact with the tender plants. For growing plants that succeed at a low temperature, and that require much air, ventilators are often placed on both sides of the roof, at the front and sometimes on the back walls. One advantage of having ventilators on all sides of the house is that by opening all a very short distance a large amount of fresh air may be admitted without causing a chill; but, on the other hand, the more ventilators used in the construction of the house the greater the cost. Side ventilators are difficult to construct and operate, as they must shut into a frame in order to make a close joint, and continued moisture during the summer and freezing weather in the winter cause them to open with difficulty, and they are soon wrenched and twisted out of shape. Ventilators on the roof are now constructed with a groove on the under side, which shuts down upon the tongue of the sash bar, as in Fig. 10, thus making a close joint and yet opening easily in all weathers. All sash fittings, like hinges, etc., should be put on with brass screws, as iron screws rust very quickly and soon rot out the wood through which they are driven.

Painting.

In building greenhouses, all the framework should be painted with a priming coat of thin lead and oil paint before being fitted, and then all joints covered with thick white

lead and oil paint before they are nailed together. In fitting the frame, all joints are nailed together with fine wire nails. A frame thus put together will last as long if well painted as where the parts are mortised together, and the cost is less.

Glass.

The glass most largely used in the construction of greenhouses is No. 2, or selected, double thick, for roof and southern walls, while No. 3, double thick, may be used for north walls, partitions, etc. The sizes used vary very much, but with the growing tendency to increase the size. That most used is 16 x 24 to 20 x 30.

Glazing.

All glass is put upon the sash bars bedded in soft putty, that shall allow the glass to press down upon the sash bars, filling up every possible space with the least possible amount of putty. Putty containing one-fourth to one-third white lead is perhaps the best. All glass must be solidly fastened in with large zinc points, small brads or other nails made for the special purpose. The glass may be lapped from one-tenth to one-eighth of an inch, or it may be fitted together with or without the zinc strip. If fitted without the zinc strip, glass should be square, and the lowest edge of each light be thicker than the upper, as in Fig. 13, that the water may run readily down the roof and not run into the house. The use of the zinc strip (Fig. 14) makes a very close, warm house; but with one with a low pitch of roof some water will work under, and the condensed moisture on the inside will drip more than when the glass is lapped or simply fitted together. The frame should be thoroughly painted before the glass is set, again after the glazing is done, and every second or third year, if it is desired to preserve it the greatest length of time.

HEATING GREENHOUSES.

This is by far the greatest problem in greenhouse construction, and there are many varying ideas in regard to it. The one thing that must be secured is an abundance of heat

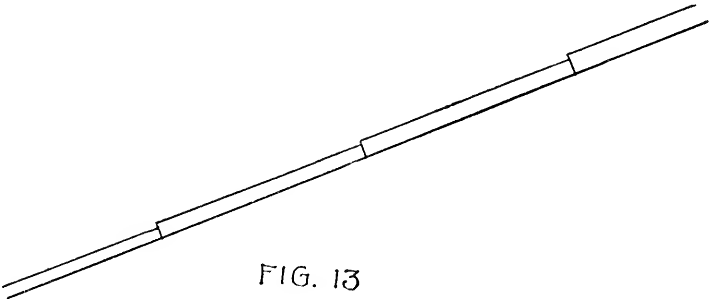

FIG. 13

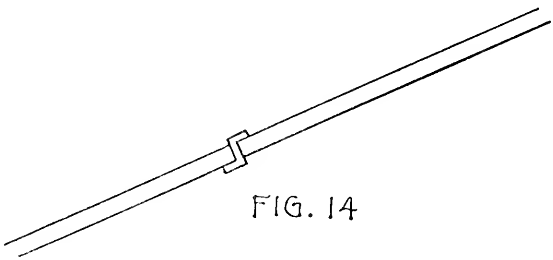

FIG. 14

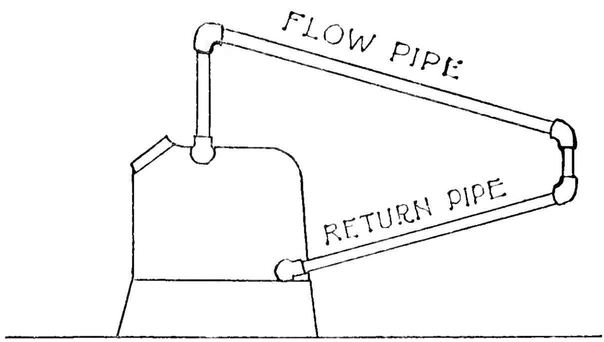

FIG. 15

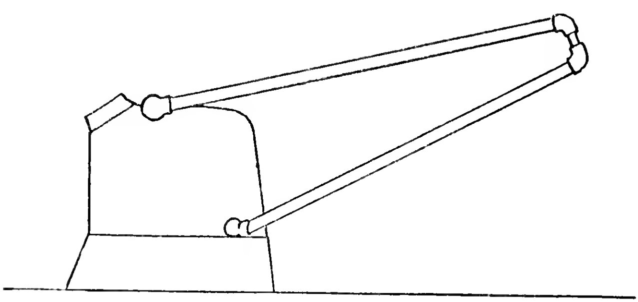

FIG. 16

for the crop grown in the coldest weather, for nothing checks plants that are growing rapidly so quickly as to have them chilled; and even plants that naturally grow at a low temperature may be seriously injured if suddenly chilled after a period of very rapid growth at a high temperature.

Steam and hot water are about equally used in greenhouse heating, the former being perhaps more largely used in heating large plants, while hot water is more used for small houses. The main advantage of steam is that high heat can be gotten up more quickly with it than with hot water, and much less heating surface of pipe is required than with hot water, thus making the first cost of steam equipment a little less than that of hot water. The advantages of hot water are that a small amount of heat may be produced during the fall or spring of the year, and heat will be secured more cheaply. With the modern method of using small pipes for distribution and radiation, both steam and hot water heat can be distributed with equal rapidity after the fire is started; but perhaps steam may be carried a greater distance than hot water, unless the latter be under pressure.

Boilers.

The number of different kinds of both steam and hot-water boilers that are now in use is very great, and many of them have reached great perfection; but it is difficult to prove that any one of the best of these is better than the others, and one must visit some of the most successful houses, and learn what are considered the best.

A boiler to be satisfactory must have large grate area, large heating surface in contact with the fire, and as much water surface as is possible directly over the fire, as it is here that the heat is the greatest and the water will be moved the most rapidly.

Most of the modern boilers are made in sections, so that the size may be varied by the number of sections used; and if one section breaks, it can be replaced by a new one at but little cost. Cast iron is largely used for greenhouse heaters, both for steam and hot water, though for large plants the

tubular wrought-iron boiler may be the most economical for generating steam.

When the establishment is large enough to warrant a night watchman, soft coal is used at a great saving in the cost of heating.

Cleaning of Boilers. — A boiler that cannot be thoroughly cleaned out, and that easily, is a very expensive one to run, as, when the heating surface becomes covered with soot and ashes, little or no heat can pass through this non-conducting mass. With the best boilers we find openings in proper places, so that brushes may be passed over all the surface of the sections; and if cleaning is done frequently, a boiler will always be in the condition it was when first put in, and most boilers work well at the first trial.

Location of Boilers. — The cellar or pit is the favorite place for locating the boilers, and it has the advantages of economy of space, and the flow pipes can be carried so high, even in a low house, as to give the best possible circulation; but few cellars or pits are dry enough to prevent the parts of the furnace from rusting, many of them are difficult to drain, or surface water sometimes runs in so as to cause much inconvenience. The modern greenhouses are so constructed that most of them can be heated by boilers standing on a level with their floors, and with proper care a boiler thus located in a shed or out-building will last many years longer than if put into the cellar or pit.

Heating Pipes.

The four-inch cast-iron pipe for heating greenhouses has been almost entirely discarded, and in its place wrought-iron water or gas pipe is used. Within the past few years small pipes from one to two inches in diameter for radiating surface have come into almost universal use in hot water heating, with one or more flow pipes large enough to supply many of the smaller radiating pipes. With the latter more radiating surface is obtained, the water circulates more rapidly, because the smaller the pipe the less water there is to heat. The pipes now used are practically of the same size as those used for steam, and the system of arrangement is very similar.

Arrangement of the Pipes. — To obtain the best results, the pipes should be placed at nearly equal intervals through the house (Figs. 2, 3 and 4), and not in large coils or stacks. Most of them should be above the benches, especially for those plants whose roots are liable to injury by too much heat and moisture, like the carnation, etc. Plants much subject to leaf diseases should have some of the pipes under the benches, as should also cutting benches and seed beds where the root growth is to be encouraged. Two methods of arrangement are most in use: Fig. 15, where the heated water rises to the highest point at once, and falls continuously to the boiler; and Fig. 16, where the pipes continue to rise from the boiler to the farthest end of the house, and then fall by a regular grade to the boiler. Both of these give good results, but in neither case should the pipes go below the grade and rise again to above the last level. The amount of pipe required will depend upon location, construction and the kind of crop to be grown, the quantity varying from one foot of heating surface of pipe to three feet of glass surface, to one foot to ten feet of glass surface.

In all cases the diameter of the flow pipes and the radiating surface of pipes should be larger than would be required to keep up the desired heat when the heating plant is run at its fullest capacity, for it is not economy to force the boiler to its utmost. Two boilers are often put in, so that one only may be run during the fall and spring, and both together during the winter when needed, and that in case of the breakdown of one the other one can do the work while repairing is being done.

Ventilating Fixtures.

Of the many ventilator "lifters" in use, those that apply the force by means of a light shaft directly against the lifting end of the sash are perhaps the best. Some of this type are very expensive, while many are low in price. The lifters that work with the shaft and elbow joint are largely in use, but greater force is required with them than with the first-mentioned types.

Beds *v.* Benches.

Of the two methods in use in growing plants, *i.e.*, the bench (Fig. 3) and the bed (Fig. 4), each has its advantage with some kinds of plants. The bed is the more easily constructed, but must be thoroughly drained, and more care is needed to keep the soil from getting into an unhealthful condition, and if it once becomes too wet, it takes a long time to get it into a healthful condition again. With the bench, a small amount of soil only being used, the soil can be freely watered, and it will drain and dry out quickly; and, while the small body of soil that is used does not allow of a large supply of plant food, this can be supplied in a concentrated form, and the bench thus be made to give rather more certain results than the bed, especially when cared for by unskilled help.

In the care of plants under glass, the aim should be to give them exactly the conditions under which they best thrive out of doors, — a rich, fresh soil, an abundance of water, yet not so much as to cause the soil to become sour and stagnant, and plenty of sunlight and air. Close attention must be given to the temperature by night and by day, the night temperature always being several degrees lower than that of the day time. If this is reversed, or if the temperature runs high after a long spell of cloudy weather, many plants become sickly and unprofitable.

Insects.

As with crops out of doors, constant attention is required to prevent injury from insect pests. The rule in regard to this matter should be to destroy the first insect that appears, and not wait until they become myriads, as they are sure to do if not promptly treated.

The soil, the amount of fertilizer to be used, the temperature required, the time and quantity of water to be used in the growth of flower and vegetable plants, are questions the details of which require too extended discussion for the limits of this article, and the reader is referred to the numerous books on the subject, and to the many successful growers who may be found in almost every section of the State.

SOME INEXPENSIVE WAYS OF MAKING FARM POULTRY MORE PROFITABLE.

BY JOHN H. ROBINSON, EDITOR "FARM POULTRY," BOSTON, MASS.

In the crop bulletin for August, 1901,* I urged upon the farmers of Massachusetts the importance of poultry keeping as a branch of diversified farming. In this paper I want to show some ways of making poultry keeping more profitable than it usually is when so conducted, giving attention especially to the possibilities of improving stock and increasing profits with comparatively small expenditure of either money or labor.

First and most important of these is the application of the principle of selection, — the great first principle in the breeding of all kinds of live stock.

Perhaps we can arrive at a better appreciation of the use we as poultrymen can make of this principle, if we take space here to consider briefly some differences between natural selection as it operates in the evolution of wild animals and plants, and artificial selection as it is used in the culture of domestic plants and animals. Natural selection operates very slowly; to accomplish marked results, it requires long periods of time. Artificial selection, when intelligently directed, advances along the lines marked out for it with a rapidity which often appears little short of miraculous. But natural selection moves steadily onward, and is not easily deprived of its gains; while the gains quickly made by artificial selection are as quickly lost, unless great care is exercised to prevent such loss.

It is because close selection is required to maintain as well as to make development that every poultry keeper needs to be fully awake to the importance of selection as an every-day, working principle. Many seem to appreciate

* Agriculture of Massachusetts, 1901, page 416.

the necessity of careful selection to develop a breed and bring it up to a certain standard, but not to realize so well that just as careful selection is required to keep a flock of thoroughbred fowls up to the average of improved stock of their kind. This is because they do not realize how highly artificial is the development of all improved races of fowls; how, under the unrestrained influence of natural selection, these fowls would have developed quite differently; and how the natural tendencies begin to assert themselves the moment the breeder relaxes in the least his effort to keep his stock at the highest point of development.

Natural selection is, as a rule, unable to make-use of marked deviations from established types, or to preserve variations which, however desirable in themselves, would diminish a fowl's chances of living and perpetuating its kind. Artificial selection is not so limited. Almost the only limitation imposed upon it is when excessive development of one quality or characteristic destroys, as it were, the equilibrium of the organism as a whole. Even under such abnormal conditions, it can often be carried to an extreme which, when we consider the original development of the feature concerned, is simply wonderful. Many of the features most prized by those who value fancy points first, and some of those most valued by those who keep fowls for economic purposes, could never have been developed under natural conditions. Of such are the abnormal developments of comb and crest in Minorcas and Houdans, and the extremely long and abundant feathers on some of the Asiatics. To the farmer who sees them, these monstrous developments are usually objects of ridicule; yet in one way at least they may be useful to him. From the possibility of maintaining these extreme forms the poultry breeder who keeps to more rational lines may be convinced of the certainty that he can get and keep any reasonable degree of development of a feature or quality which he desires in his stock.

We may be able to get a still better — a broader — idea of the value of this principle of selection, if we reflect on how well and how quickly the work of making the breeds

which we now group together as the American class was done. These are what are called "made" breeds. In one sense, all breeds are made breeds; but we don't know that any one ever deliberately went to work to make the Light Brahma, or the Black Spanish, or the Dorking, or the Houdan, while these American breeds, with a possible exception, were "made to order." The Barred Plymouth Rock, the oldest of them, has been before the public only about thirty years.

Varieties so widely popular as the White Wyandotte and the White Plymouth Rock were very new ten or twelve years ago. Buff Plymouth Rocks and Buff Wyandottes may be said to have been made within ten years; and the exhibition Rhode Island Red is of even more recent manufacture. In developing all of these varieties the elementary rule has been: careful selection of breeding stock, for the purpose of producing fowls of a certain ideal type, which ideal type, though not uniform in the minds of all the breeders, was far more uniform than the fowls themselves, and very much in advance of the actual results obtained.

Coming now to the direct application of the principle of selection in poultry breeding to methods of farm poultry keeping, let us begin with the consideration of the conditions on farms — that is, on ordinary farms.

There are a great many farm poultry keepers who, while recognizing the uses of selection, do not see how necessary it is that they should take specific measures to insure that a right selection is actually accomplished.

It is often said that natural selection is constantly working for the improvement of every stock of poultry, even when the owner makes no special efforts for improvement. It is argued that, as the best and most vigorous males fertilize the most eggs, and the best hens lay the most eggs, the greater part of the chicks produced each year must necessarily be from the best of the stock; and thus there will be constant improvement. This looks plausible, but the argument goes to pieces as soon as we begin to examine it.

To my mind, a sufficient answer to it is found in the fact that flocks of poultry left to improve in that way invariably

deteriorate, or at the very best show no perceptible improvement. But every one may not agree as to the weight of that fact as an argument; so, to any who disagree with that, I offer another argument, which I think they will admit is reasonable, which will show how unlikely it is that natural selection, acting as indicated, should have any considerable influence in improving a farm flock.

In the first place, the poultry keeper who does not carefully reserve his best birds rarely breeds from the best of any year's produce. His earliest and best pullets and cockerels go to market, because they bring best prices when sold for table consumption. And, even if the flock does each year contain some of the best of the produce of the preceding year, it is by no means certain that the greater part of the chicks from the flock will be from unions of best males with best females, or that the best birds will give the most numerous progeny. It often happens that an inferior male is a much surer breeder than one vastly his superior in all points the poultry keeper prizes. Then, as to the hens: in the case we are supposing, the best-developed pullets and best-conditioned hens lay earliest, and generally begin laying a long time in advance of the hatching season. As a rule, these are the first hens to go broody, and — broodies being always in demand early in the season — they will almost certainly be used to hatch and rear chicks. The eggs upon which they are set will not be their own eggs, laid when they were in full vigor, but eggs from the general flock. If any of their own eggs are among these, it is simply the tailings of the produce of that laying period. Under such circumstances, the best hens may hardly figure at all in breeding operations, and the chances are that very few of the chicks produced are from the best hens of the flock, and fewer still from any of these best hens at the time they were most fit for breeding.

When we note how often it happens that a breeder who carefully mates up a pen of choice fowls from which to sell eggs for hatching fails to get eggs from them when he wants them most, it seems absurd to suppose that, under a careless and haphazard system, this trouble would be avoided regu-

larly enough to make improvement through natural selection. Natural selection, as has been said, does operate in the poultry yard; but, the lines of progressive development being largely artificial, its general tendency is to retard rather than to accelerate such development. Progress along the artificial lines of development, which have given to domestic plants and animals their peculiar value, may with truth be said to be always the result of design on the part of the breeder, — of design accomplished through intentional, intelligent and systematic selection. Wherever you find a really good flock of fowls, though they may be only mongrels, you will find that the man or woman in charge of them has some system of selection which will account for the excellence of the flock. It may not be as comprehensive and thorough as the methods of an expert and critical breeder, and will not make as great improvement or improve so rapidly, but it will at least save the flock from marked deterioration.

There are several ways by which a farm flock can be kept up to a very good standard of excellence for practical purposes, by just a little effort of the keeper. Thus, where it is the practice to take the eggs used for hatching from the general flock, if, besides reserving his best pullets, the keeper weeds out all the decidedly inferior ones, and uses only well-developed males, any one of which would be considered a desirable breeder, the stock cannot go back very rapidly, even though, as we have seen, there might not be enough of the product in any year from the best birds to strongly impress their quality on the flock.

It is such selection as this, accompanied by selection of the largest eggs for hatching, that is practised on most farms where some special attention is given the matter of making poultry profitable. It is doubtful whether any marked progress was ever made by such methods, but they are a long way in advance of leaving it all to nature. At best, these methods are crude; their use under the conditions described is illogical.

The logic of such a situation requires that a poultry keeper, who realizes the importance of reserving his best fowls to

breed from, should make sure that it is only the eggs of his best hens, fertilized by his best males, that are used for incubation. The logic of the situation requires that a poultry keeper who thinks it worth while to select the best eggs for incubation should, sooner or later, come to consider it necessary to know that these eggs were from hens possessing the other qualities prized, and fertilized by males most suitable for mating with these particular hens. Selection is not complete if it stops short of the separation of the fowls selected, — unless the whole flock is select, — a thing which does not often happen. It is in failing to make selection complete and effective by separation that nine-tenths of the poultry keepers who do not breed for fancy points make one of their most serious mistakes. Separation would not be so necessary if the whole flock were needed to produce the number of chicks wanted. In that case, it would be simply a question whether the additional product secured by using the poorer as well as the better breeding birds would add to the profit. But, with the exception of those who sell eggs for hatching, there are few poultry keepers who could not get all the eggs needed for incubation from a small part of their flock. In that case, it certainly seems the best policy to use for breeding purposes only as many of the choicest of the flock as are really required. Then, even though it may sometimes happen that the best hens do not furnish eggs when most wanted, the poultry keeper can know that he is using the best eggs available, and using none from inferior hens.

Suppose that there is on a certain farm a flock of one hundred hens; that this is the amount of the laying stock usually carried; and that each year about three hundred chicks are raised. It would be possible to produce all these chicks from a half a dozen hens. That, however, would be much better than average results. A dozen hens can produce the eggs for these chicks, and do it handily. Is it not, from every consideration, better to have all the chicks from the twelve best hens than to have only ten or fifteen per cent of chicks from hens of this quality and eighty-five or ninety per cent from the rest of the flock?

Aside from the special poultry farms and the farms of farmers who are fanciers, there are few farms, either in Massachusetts or in any other State, where selection and separation of breeding stock is practised. Still there are a few, and their number is increasing; and it is very rare indeed to find any one who has given that method a fair trial going back to the old way of haphazard breeding. That way is too wasteful for people who need to be economical, as every one should be in poultry keeping; for profit in poultry depends very much on economy in production.

In the first place, the haphazard way involves those who use it in quite an expense for superfluous male birds. For one hundred hens there must, as a rule, be six or eight males: with a less number there may sometimes be good fertility in the eggs from the flock, but the numbers given are more common. Now, if only twelve of the hens are actually needed to produce eggs for hatching, one male is enough to fertilize their eggs. We may set aside another, to be held in reserve in case of an accident, or in case the male used in the breeding pen fails to give satisfactory fertility. All other males kept with the flock are superfluous. The poultry-man who keeps superfluous males is "out" just the cost of their food, plus the difference between the price of soft roasters and the price of old roosters on each bird, — to say nothing of the occasional *dead* losses, resulting from quarrels of these pugnacious fowls. This is money that might be saved, or put where it would earn something.

A good way to use it is in the purchase of a male bird of superior quality. To most farmers the prices asked by poultry breeders for males that are what the farmer ought to have to improve his flock seem outrageous; yet, even at the high prices at which they are held, such birds, if properly and economically used, would be much cheaper than the kind the farmers too often buy, because the price is more nearly what they think they ought to pay.

I recall an instance illustrating this point nicely. It happened some years ago in Colorado, where the farmers on "dry" farms or on irrigated farms having water rights of

late date have to nurse the resources of their land quite as carefully as any of the farmers on rocky New England farms. I was breeding a line of very large Buff Leghorns, and sometimes for late hatches I crossed the males on Buff Cochin and Brahma hens. The produce of this cross was not unlike the Rhode Island Red, and proved very attractive to farmers who saw it. Early one spring a farmer whom I knew very well came to me to buy a cockerel. After seeing some of these cross-bred hens and learning how they were bred, he said he had some hens that looked a good deal like Buff Cochins, — perhaps twelve or fifteen of them in a flock of sixty or seventy hens; and he thought he would take a Buff Leghorn cockerel and mate with them, separating them from the rest of the stock. But the only bird of that variety I happened to have that I could sell was one I had been keeping for a reserve bird, — a big, well-built fellow, too good in color to use merely in cross-breeding; and I held him at a figure I thought no ranchman would pay. So I tried to sell him a Brown Leghorn, of which I had on hand a few birds at prices that would suit him better, though none of them had the size and shape of the Buff one. Finally, when he insisted on my giving him a price on that bird, I told him he could have it for four dollars. He went away without buying a bird. A few days after he came again, wanted to know if the bird had been sold, and, learning that he had not, said, "Well, if you'll take it in hay, I'll take him." I agreed to that, and he took the cockerel away with him, having first exacted a promise that I would not tell "the old woman" the price of the bird.

Next fall he came to me one day to tell me how well he had done on that investment. Hatching only from that one male, mated with a few of his best hens, he had the evenest and quickest growing lot of chicks that had ever been on the farm. The cockerels hatched at the usual season had been ready for market before prices went down; the pullets well grown, and beginning to lay before winter; and, taking it all in all, he estimated that they were something like fifty dollars better off than if he had bought a small, cheap rooster. "But," he said, as he concluded his story, "I haven't told my old woman yet what I paid you for that rooster."

I don't want to be understood as in any way implying that the fancy poultry breeder's scale of prices is adjusted to the values of his birds to farmers, or for practical breeding purposes. The position I take is, that in buying stock to improve his flock the farmer should not take birds that have not in marked degree the qualities he desires to introduce into his flock. If he can get at a low price birds that are culls for some superficial defect, not affecting their real value, so much the better; but if he cannot get the qualities he wants in a low-priced bird, it is much cheaper in the end to buy a higher-priced one; and the point I especially want to bring out here is that in a great many cases the superfluous males on a farm, sold at market prices, would bring the price of a really good thoroughbred bird.

Or, if one has one or more male birds — as many as he needs — that are as good as he needs, what is saved by disposing of unnecessary male birds will go a long way toward the expense of providing special quarters for the breeding stock. It is this item of expense, I think, which deters a great many from separating their breeding stock, even after they are ready to admit that that is what ought to be done. This expense, however, need not be considerable, and the special quarters for breeding stock will certainly pay for themselves several times over in the first season they are used, if other things are as they should be.

There are other applications of the principle of selection which may profitably be employed by the farm poultry keeper. The influence of natural selection is by no means limited to the phenomena of reproduction. Indeed, if the theory of natural selection supposed the operation of the principle more energetic at one stage of life than at another, that was the growing stage, and particularly the earlier part of it. The phrase "survival of the fittest" inevitably suggests the destruction of the unfit. Yet this is the point where nearly all poultry growers, whether farmers or fanciers, seem to come to a standstill. There are few who will not admit that it is better for the brood and flock, more profitable for the keeper, and kinder to the chick itself, to kill the weakly chicks as soon after hatching as their weakness is discovered; and to follow this by taking away from

the flock every chick that fails to grow properly, and so lags behind the rest in development. But it is a very rare thing to find a poultry keeper who will do this. The usual practice is to let everything live until it is marketable, — or dies from natural causes.

And it is just this that is responsible for more than half of the troubles people have in growing chickens. It is on the weak and puny chick, that has not life and strength enough to dust itself, that lice increase, until they become numerous enough to worry the strong chicks. It is the weak chick that develops distempers and diarrhœas, and poisons the air for the others with its fetid breath, and makes the coop or brooder foul with its slimy discharges. It is after the weak chicks that one must be constantly cleaning up; their presence in a flock is always adding to the poultry keeper's burden. I never could understand why people should be so reluctant to kill a fowl or animal which they knew was not fit to live, and probably would not live to meet the use for which it had been produced.

When we plant seed, we plant enough to allow for the failure of a great many seeds to grow, and still give a great many more plants than can be properly grown on the allotted ground. Then, as the plants grow, they are thinned out, all the weak and unthrifty ones being uprooted like weeds, and no more of the thrifty spared than can make good growth. The same thing should be done with the chickens. No unthrifty ones should be allowed on the premises, and the thrifty and vigorous should not be overcrowded. If they are, they do not long remain vigorous and thrifty.

Besides being a constant menace to the welfare of the flock and a burden to the caretaker, the weakly and runty chickens are rather costly property. It takes a great deal more food to make meat on them than on strong and thrifty chickens. No scientific experiment is needed to demonstrate this. Any one who has weakly chickens in his flock can demonstrate the matter for himself by separating them, by taking an equal number of healthy chicks of the same age, and noting how the two lots eat and how they grow.

The weakly lot will eat nearly if not quite as much as the others, and hardly grow at all; while the others are gaining perhaps over an ounce a day. When finally the weak ones that live have attained marketable size, they will in most cases have cost more than they will bring, and they never make good poultry. The loss on them is least when they are cleared out as early as possible. Not one time in ten is anything gained by keeping them, in the expectation of finally realizing a little something on them. It is safe to say that this class of losses cuts the profits of nearly all poultry keepers far more severely than they realize.

The matter of overcrowding has been mentioned. It is a thing to be avoided as one would avoid a contagious disease. People do not comprehend how injurious overcrowding is, unless they have opportunity to compare results when two similar lots of chickens are kept, one in crowded quarters, the other with abundant room; and this opportunity for comparison seldom comes except to those who intentionally make it.

"Farm range" for growing chicks ought to mean a great deal. Too often it means very little, — means only that the chicks are on a farm, and are not confined. The "range" is so overstocked that they get next to nothing of what they are supposed to get on a range, — green food and insect food; and, these not being supplied to them (because, being on "free range," (?) they can procure them by foraging), they are in effect worse off than yarded fowls, to which these things are supplied. If one desires to use free-range methods, he must take care not to overstock his range. If he desires to keep more fowls than can be suitably kept on his place by such methods, he must to some extent adopt the methods of intensive poultry culture.

Overcrowding, overstocking premises with poultry is a fault common to all classes of poultry keepers. It is only here and there that you find one avoiding it entirely. Fanciers are most likely, while giving fowls sufficient house room, to limit them too much in the matter of yard room; while with farmers it is apt to be the other way. Between the two evils there is nothing to choose, and no choice

should be made. There should be sufficient indoor room, and that in a suitable building or coop for both fowls and chicks, and a generous allowance of room outdoors. While it is unquestionably better for fowls not given enough room outdoors to have a roomy house than to be crowded indoors as they are out, and better for fowls given coops only big enough to roost in that they have a good range during the day, the best results cannot be obtained by subjecting fowls to unfavorable conditions half the time; and it makes little difference whether that half is day or night.

For best results there must be uniformly good conditions. "Whatever is worth doing is worth doing well." If it is worth while to utilize the farm land for poultry, it is worth while to properly house what fowls are kept. If the expense of putting up buildings for what fowls can be kept on the land is too great at first, the proper balance of conditions can be maintained by reducing the numbers kept to what can be properly housed. The common experience of poultry men who make a specialty of poultry is that the flock so limited in numbers not only pays a better profit per head, but also a greater total profit than when the premises are overstocked. Market reports this season have furnished an illustration of this point on a very large scale. After prices of grains went up last fall, buyers of poultry throughout the country reported that the stocks on the farms were being very much reduced, and it was predicted that on this account there would be a shortage of eggs and poultry this season. There was a shortage of eggs early in the winter, because even fewer flocks than usual were producing; but after the hens began laying the production was greater than last year. It is altogether probable that this is because the reductions of the farm flocks made the conditions so much better for the fowls that remained that their average production was very much increased.

In conclusion, let me urge on farmers who want to make their poultry as profitable as possible, a point which, when first stated, may not seem to fit the subject of this article. It is this: never stint your growing chicks on feed. Let them have all they can eat and digest properly. Don't

starve them to make them hunt for food. If possible, spread them out over the farm so that they can get what grass they need, and some insects, without running about much; then either feed them often, or keep food standing before them.

The farm-grown chick ought to make the very best of poultry; but the ordinary farm-raised chick does not. Nearly all of those who grow poultry on farms think their poultry is as fine as fine can be; but the common farm chicken does not compare in quality with the finest poultry in our markets, because it is not so well fed and quick-grown, and runs about so much that it early becomes quite hard-meated. Rapidity of growth means as much in the quality of a fowl as it does in the quality of a vegetable like the beet; and to make quick growth there *must* be food in abundance, and *must not* be too much exercise. Exercise is a good thing. Enough of it to keep the system in good condition is necessary; more is too much of a good thing.

To attempt to economize on cost of growing chicks by keeping them on just about a maintenance ration is not good policy. The quicker you can get the cockerels ready for market the more you will save in labor, — and in feed too, — and the better will be your returns when you sell them. The earlier you can bring the pullets to a well-developed maturity, the better will be your prospects of eggs when eggs are highest.

Don't keep either moulting hens or growing chicks on short rations, because they are not adding anything to the current income. Feed to bring them into earning condition as soon as possible, and to secure the best possible development of their qualities. If you happen to have more stock on hand than you can feed, while it is not earning, as it should be fed, cut it down to what you can carry, and you will be better off in the long run. It is a great deal better to have a small flock earning something, be it ever so little, in the early winter, than to have a large flock that was only half fed through the fall running behind until it takes the most of the next season to catch up. To feed to satisfy all the requirements of the fowl is in the end the most inexpensive way.

CUCUMBER GROWING IN MASSACHUSETTS.

BY PROF. GEO. E. STONE, PROFESSOR OF BOTANY, MASSACHUSETTS AGRICULTURAL COLLEGE.

The cucumber industry is of some importance in this State, when one takes into consideration the amount of fruit grown under glass and that grown out of doors. It was not many years ago that cucumbers could be obtained only during their natural season. This, however, is not true at the present time, inasmuch as cucumbers can be obtained in the market at any season of the year. In some sections of the State there are many greenhouses devoted to the production of winter cucumbers under glass, which frequently bring a high price. These are not only grown to supply the Massachusetts markets, but many of them are shipped to New York. The winter prices of cucumbers range from $0.75 to $3 per dozen, according to the season, and even at $1 per dozen there is a fair return for the care involved and labor expended on their production, providing diseases do not interfere with the normal yield of the crop. The production of greenhouse cucumbers in this State is on the increase, as shown by the building of many new houses each year, which are either wholly or partially devoted to cucumber growing. The increase in the number of cucumber houses is not so great as in those devoted to lettuce. Since, however, most lettuce growers raise a spring crop of cucumbers in their houses each year, the production has increased. The growing of outdoor cucumbers is carried on extensively in some localities. In one small section of the Connecticut valley one hundred acres or more are grown.

The Cucumber Plant.

The cucumber (*Cucumis sativus* L.) belongs to the cucurbitaceæ or gourd family, to which other important economic plants, such as the melon, squash, pumpkin, etc., belong.

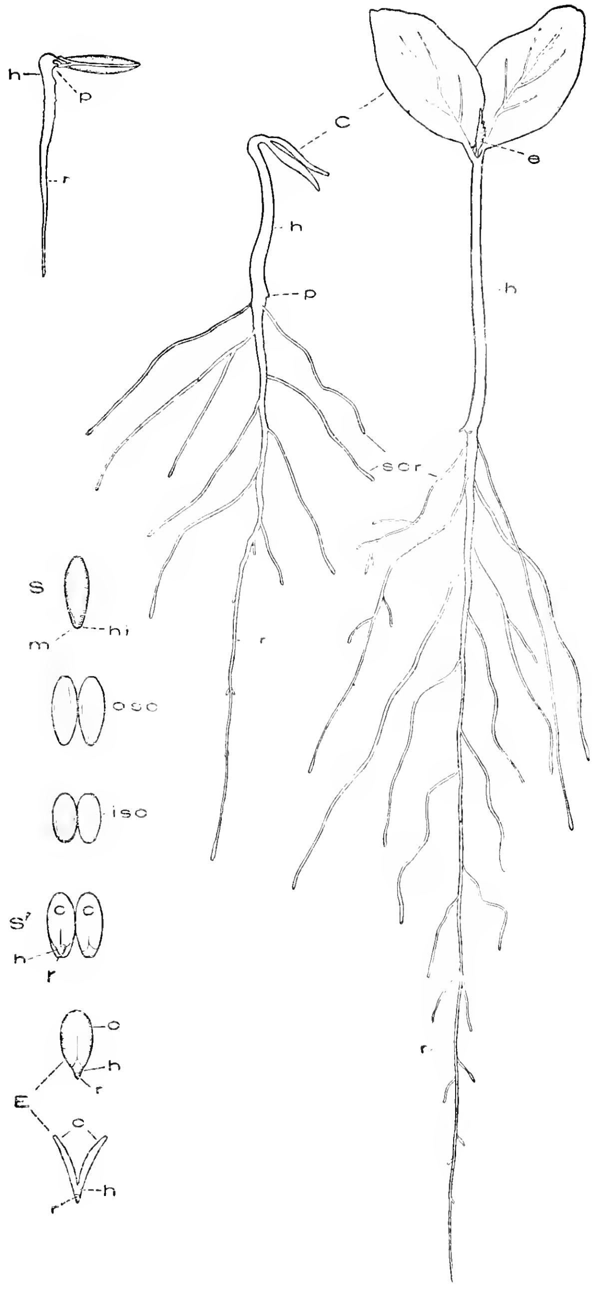

FIG. 1.—Showing three stages in the development of the cucumber seedling: *S*, seed; *S'*, seed split in halves; *E*, embryo; *hi*, hilum; *m*, micropyle; *r*, radicle; *h*, hypocotyl; *osc*, outer seed coat; *isc*, inner seed coat; *c*, cotyledon; *e*, plumule; *scr*, secondary roots; *p*, peg.

It is a dicotyledonous plant, *i.e.*, it has two cotyledons or seed leaves, which are familiar to all who have observed its germination and development. The cucumber seed is of medium size, and not particularly well supplied with an over-abundance or great variety of reserve material for independent growth, as shown by its habit of throwing up its cotyledons quite early in its period of development. The cotyledons are withdrawn from the seed coat at an early period, and as soon as they become exposed to the light they turn green. At this period they commence to assimilate food from the air, through the ability of the green cotyledons to decompose the atmospheric carbon-dioxide under the influence of light.

The principal reserve materials which seeds contain are starch, proteids and oils. All seeds, however, are not supplied with these three reserve material constituents, but, on the other hand, they may possess only two of these, such as proteids and oils. Such seeds as the pea, horse bean, etc., which contain an abundant supply of the three kinds of reserve material, do not lift their cotyledons into the air, but remain submerged; whereas such plants as the sunflower, white lupine, etc., that contain only proteids and oil (which constitutes a one-sided and incomplete supply of reserve material), immediately push their cotyledons above ground. The reserve material endowment of this latter class of plants causes them to unfold their cotyledons and expose them to the light, by which means they are enabled to assimilate food from the air, thus supplying their inherent deficiencies.

The seed of the cucumber belongs to this latter class, *i.e.*, it contains proteids and oil as a reserve material, but no starch. Hence arises the necessity of utilizing its cotyledons as assimilating organs at a very early stage in its development, in order that the plant may be supplied with carbohydrate material for metabolism and growth. Fig. 1 shows an illustration of the seed of the cucumber and its various parts, together with the seedlings in different stages of development. Usually one end of the seed is thinner and more pointed than the other. The pointed end is where the root protrudes during the process of germination, and

is that part of the seed where it is attached in the ovary or fruit, as is shown by the scar, which is known as the hilum. When seeds are soaked in water for a few hours, they swell up. If we squeeze a water-soaked seed, it will be seen that water exudes at the hilum end. This is because there is a pore at that end called the micropyle, which enables the seed to absorb water readily. The seed is provided with two coats: an inner one, which is thin and transparent; and an outer one, which is opaque. Inside the coats is what is called the embryo, which consists of two cotyledons, or seed leaves; the radicle, or root; the hypocotyl, or that portion of the stem under the cotyledons; and the plumule, or developed stem. The embryo constitutes a minute plantlet. Three different stages of germination are also shown, and the various parts which we saw in the embryo have become greatly extended and developed. The cucumber plantlet has an ingenious and peculiar way of getting out of its coats. The one-sided outgrowth (*p*) near the radicle and hypocotyl, known as a peg, acts as a lever in spreading the micropylar end of the seed, by which means the cotyledons may be more conveniently withdrawn.

Varieties of Cucumbers grown.

Most of the varieties of cucumbers grown in greenhouses are the White Spine or some similar strain, and in many instances a Hybrid type is grown. This usually consists of a cross between the White Spine and Telegraph, or some other English type of cucumbers. The Telegraph bears large fruit, generally from 18 to 20 inches or more in length, and is largely used in forcing houses in England. In this country it does not find so ready a sale as the shorter varieties. Many people, however, who have eaten the long English Telegraph, like it; and, if it were found more extensively in the markets, there is no doubt but that it would be utilized more largely. A stock of White Spine having about one-fourth of the English Telegraph in it (which constitutes the Hybrid type) makes a cucumber slightly longer than the White Spine, and of a considerably darker color. The quality of the Hybrid is good, but is not superior to the

White Spine. The darker-green color makes it more desirable for some marketmen than the lighter-colored White Spine. The vine of the English Telegraph is a more rapid grower than the White Spine, and perhaps more inclined to wilt than the latter. The Telegraph, so far as our experience goes, sets all its fruit on the laterals; whereas the White Spine and other varieties bear some fruit on the main shoot.

Types of Houses devoted to Cucumbers.

In the economic production of cucumbers under glass, the style of house utilized plays an important role. As a rule, cucumber houses have double glass, *i.e.*, they are constructed out of two layers of glass set about $1\frac{1}{2}$ or 2 inches apart, leaving an air space in between. The object of this is to prevent the radiation of heat, or, in other words, to save coal. Most cucumber houses are from 15 to 23 feet wide, and scarcely ever exceeding 200 feet in length. They have benches along the sides and in the middle, the side rows of cucumbers being trained up the sides and roof, while the middle ones are trained vertically. These houses are usually heated with hot water. The beds are generally slightly raised above ground, and contain in depth about 1 foot of soil. They are frequently provided with porous tile, which is used for the purpose of sub-irrigation, and, if necessary, can be used for sterilizing the soil. When cucumbers are grown in lettuce houses, they are planted directly in the ground beds, the rows, some 8 or 10 feet apart, being trained in the form of the letter "A." The type of house utilized by lettuce growers is preferable for the production of cucumbers grown at any season of the year, but there are only a few instances where this type of house is used exclusively for this purpose. The light conditions and exposure of the plants are much more favorable when grown in a lettuce house than when grown in a typical cucumber house. Lettuce houses are wider than cucumber houses, and generally longer; but, notwithstanding this, they can be built at a less cost per linear foot than houses which are narrower. From a large number of statistics which we have obtained relating to the cost of various types of houses

devoted to cucumbers and lettuce, it is evident that the largest houses cost the least, whether reckoned by cost per linear foot or cubic contents. For example, a house 40 feet wide can be built proportionally cheaper than one 20 feet wide. The average cost per linear foot of a number of houses ranging from 18 to 23 feet in width, without piping or boiler, was $18.86; that of a number of houses 36 to 40 feet in width averaged about $10 per linear foot. From these figures it is clear that a large house costs less per unit of structure than a small house, and the cost of operating the same is less. The cost of crop production is cheaper in a large house than in a small one; and it would be more economical to manage one large house, 40 by 300 feet, than three small ones, 20 by 200 feet, having the same total area.

Transplanting Cucumbers.

Most greenhouse cucumber growers start their seed in boxes, or in beds in special houses. When the seedlings are from 2 to 4 inches high, they transplant them into pots; they are allowed to grow 6 to 8 inches high in pots before transplanting in the house. Some growers transplant twice in pots, and, as a rule, the seedlings are planted deeper each time in the soil, so that the cotyledons are just above the surface. It is claimed that a better root system is developed by this practice. The principal object to be gained by transplanting cucumbers is the saving of space, time and heat. Plants sufficient for a large establishment can be started in a small house especially devoted to seedlings, which does not require much expense to operate; whereas, if the seeds are sown directly in beds, and not transplanted, it is necessary to go to the expense of heating a large house. It is also claimed that transplanted cucumbers will grow faster and make better plants. Our own experiments have not verified this statement, as we have never seen any difference in size of our plants, whether they were transplanted or sown direct in the beds. Other than the saving in space, heat, etc., which are important, we have never seen any advantage in transplanting cucumbers.

Temperature required for Indoor Cucumbers.

Where cucumbers are grown under glass, it is necessary to supply them with considerable heat, the night temperature required being about 65° F., and the day temperature about 85° F. The temperature requirement varies with the condition of the weather. Higher temperatures can be maintained during sunshine than during cloudy weather. Houses are frequently run in the day time at a temperature exceeding 85° F. High temperatures during cloudy weather will produce a weak growth, lacking a sufficient texture of foliage, etc., which would result in the plant possessing a marked tendency to wilt in strong sunlight. The conditions which cucumbers are subject to under glass are by no means the same as those which occur in the summer out of doors. Indoor cucumbers are subject to very different moisture conditions, and in the winter the light is none too good for a plant whose requirements demand strong light. In order that cucumber plants may be induced to grow under these adverse conditions, heat is substituted for light, as a stimulus: which results in producing plants possessing a much more delicate structure, and consequently rendering them much more susceptible to certain diseases. All cucumber crops grown under glass are more or less abnormal, or, in other words, they are forced: but there is considerable difference in the amount of forcing they receive by different growers, owing to different conceptions of manipulating the crop.

Fertilization of Flowers.

Cucumbers are monœcious plants, *i.e.*, the sexes are borne in separate flowers on the same plant. For this reason, when cucumbers are grown in greenhouses it is necessary to resort to hand pollenation, or else to employ bees to carry the pollen from the staminate to the pistillate blossoms. Bees are generally abundant enough in summer to accomplish fertilization of outdoor crops. It is stated, however, by some authorities, that certain varieties of cucumbers, such as the Telegraph, or long English types, do not require fertilization, inasmuch as the fruit matures, whether fertilized

or not, in which case a seedless fruit is formed. Crooked or imperfectly developed cucumbers are not infrequently produced on vines. It is maintained by some authorities that crooked or ill-formed fruit is the result of imperfect fertilization. In many instances this is no doubt the case, but there are other causes underlying the production of inferior formed fruit. It can be safely stated, however, that good plants are endowed with the capacity to produce good fruit, and conversely that it must not be expected that perfect fruit will be produced on weak plants. From our observations we are led to believe that crooked or imperfectly developed cucumbers are in the largest number of cases produced by plants which are not normal. For example, plants affected with nematode galls, or weakened by thrips, etc., will develop poor fruit. Anything, in fact, that affects assimilation or interferes with the normal function of the plant weakens it, and the result is poorly developed cucumbers.

Pruning Cucumbers.

When cucumbers are grown under glass in winter, the amount of space the plants occupy, together with the amount of fruit which they produce, is of prime importance, from an economic point of view. Under these conditions it is quite essential that as many plants shall be grown as possible, without overcrowding or interfering with conditions suitable for maximum production. To secure the best results in the least space, the plants are trained on wires or sticks, in order to use space to the best advantage. The cucumber plant is a prolific grower, and requires a great deal of space if allowed to develop naturally. As there is nothing to be gained in allowing a plant grown under glass to develop in its own manner, the practice of pruning is resorted to. Since the question of utilizing valuable space is an important one, it is necessary that the production of the greatest amount of fruit should be restricted to the least possible space consistent with the normal requirements of the plant. One of the objects of pruning is, therefore, to confine the growth of the plant to certain definite areas, and to concentrate the formation of fruit on the plant to cer-

tain desirable positions. In the growing of outdoor cucumbers pruning is not practised, so far as I am aware, but it might be in some instances to advantage.

The two common methods of training are known as the single and double shoot systems. In either case the laterals which arise from the main shoot are treated in the same manner. In the single-shoot system a leader is allowed to grow together with all the laterals or axillary branches which normally occur in the axil of each leaf. As a rule, fruit sets in the first axils of the laterals, and in case this happens the laterals are pruned or the bud nipped at the second leaf on each lateral (see Fig. 2, *c*). By nipping the bud or shoot at *c*, a new lateral will form at this point, which, if allowed to grow, will form another axillary branch, which will set fruit as a rule in the first axil, as shown in the figure. The new lateral can be treated in the same way as the others, *i.e.*, it can be cut or nipped back at c^1. As new laterals are formed they can be pruned in a like manner, as a result of which we will have axillary branches of the first, second, third order, etc., bearing fruit in their first

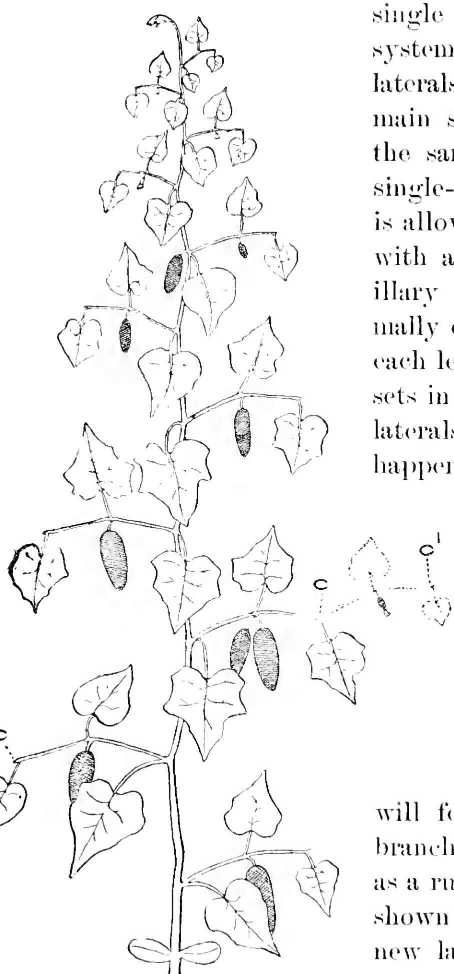

Fig. 2. — Showing the single shoot cucumber plant, with fruit set in the first axils of the laterals. The laterals are pruned at *c*. The dotted lines represent a new lateral, or tertiary branch, formed on an axillary, which is also nipped at c^1.

axils. Sometimes, however, fruit does not set in the first axils of the laterals, but may in the second or third axils. In that case the lateral is nipped at the first leaf beyond, or at the third or fourth node of the lateral. By this method of pruning there is a concentration of fruit on the plant to parts near the main shoot; for if the laterals were allowed to grow, they would as a rule produce fruit only in every seventh axil, as is the case with the main shoot. From numerous observations which we have made on various crops, we have found that a very large percentage of the pistillate flowers of the laterals occur in the first axils. The largest number of internodes occurring between the successive formations of fruit on the plant was seven; in other words, fruit is found in the largest number of cases in every seventh axil.

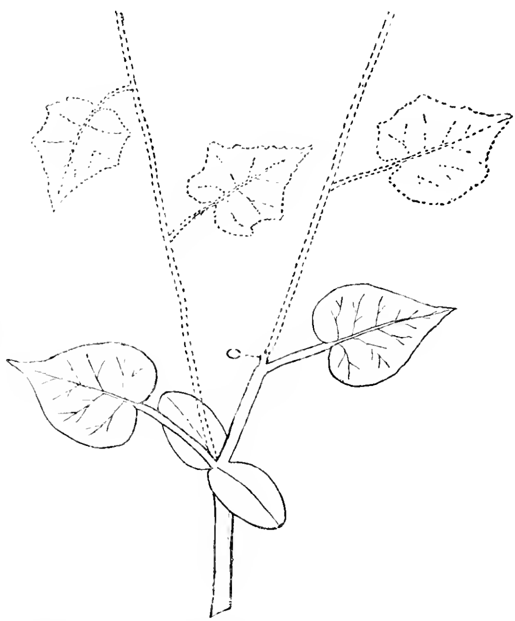

FIG. 3. — Showing the development of the two-shoot system. The leader is cut at *c*, and two new laterals or leaders develop, as shown in the dotted lines.

In the development of the two-shoot system it is necessary that the plants should be manipulated when small, or at that period when two leaves have developed. The plant in this stage of development is shown in Fig. 3, in which case the dotted lines represent the plant as it will appear as a result of cutting the leader at *c*. The cutting is best accomplished with a sharp knife, when the bud of the leader is very small. This causes a shoot to develop in the axil of the cotyledons and another at *c*. In this case we have a plant where two laterals form

the two leaders. The subsequent process of pruning is similar to that described under the single-shoot system.

There is a difference of opinion as to the relative merits of the single and double shoot system, some cucumber growers preferring the one-shoot system, and others preferring the two-shoot system. On this point, however, it may be stated that cucumbers do not stand overcrowding; and when they are planted in the greenhouse 2 feet or 30 inches apart, we believe the single-shoot system is equal if not superior to the two-shoot system. In some of the largest crops of cucumbers which we have ever observed the plants have had ample room for development. In one instance, where a third row of vines was planted in a good-sized house, the crop was only one-third of that where two rows were planted.

A number of experiments have been made by us in pruning cucumber plants; space does not permit us to go into a full discussion of the results of these experiments at the present time. However, some of the main points deducted from them can be pointed out in a brief manner.

In one experiment that was made on all the plants constituting a crop, in which case a single leader and several of the laterals were allowed to grow without pruning, the following points were noticed: —

The average yield of fruit on the main shoot was 18 per cent higher than upon the laterals. The lowest laterals, or those nearest the base of the plant, came next in the production of fruit, and the others or higher laterals followed in uniform succession in fruit production. The maturing of the fruit was more marked upon the main shoot than upon the laterals. Of the various laterals, the lowest ones most nearly approached those of the main shoot in maturing its fruit. The main shoot showed a gain of 36 per cent in maturing of the fruit over that of the first lateral. Of the fruit formed on the laterals, 61 per cent occurred in the first axils. The number of internodes between successive formation of fruit on the plant was in the largest number of cases seven.

In another experiment in the same house the plants were

allowed to develop a single leader, and as many laterals as would appear. The latter, however, in this experiment were pruned at the second leaf, or, in case fruit did not set in the axil of the first lateral, they were pruned just beyond the axil where it did set, but it was usually at the second axil. It was found in this experiment that there were 30 per cent more flowers of both sexes on the laterals than on the main shoot, and that there were 53 per cent more staminate than pistillate flowers on the whole plant. It was further found that there were 93 per cent more pistillate flowers on the laterals than on the stem or main shoot; and, of the total number of pistillate flowers which made their appearance on the laterals, 87 per cent were found in the axils of the first leaf, whereas only 13 per cent were found in other axils. There were practically no differences in the maturity of the fruit found on the main shoot and laterals in this experiment. In these two experiments we have a chance to compare the differences existing between plants where the laterals were pruned and those that were not pruned, the latter or unpruned ones forming all the laterals they desired. In the first experiment, where the laterals were not pruned, the yield of the fruit was 18 per cent higher on the leader or main shoot than on the laterals; whereas in the latter experiment, where the laterals were pruned, this was reversed, and in this case there was 93 per cent more fruit formed on the laterals than on the leader. In the first experiment, the fruit on the leader matured earlier than on the laterals; in the latter experiment, where pruning was practised, there was practically no difference. Cutting the leader of the main shoot or pruning the laterals caused an increase in the number of laterals. Where laterals are not cut, they are not formed as a rule in the axil of every leaf. Pruning appears to cause a larger amount of fruit to set in the first axils of the laterals, as it was found that in the experiment where pruning occurred 87 per cent of the axils contained fruit, against 55 per cent where no pruning took place. In some instances, where the leader was nipped on unpruned plants, this succeeded in causing a slight increase in the amount of fruit in the first axils of the laterals.

In conclusion, it may be stated that the advantages of pruning are that the fruit is concentrated on the plant to a greater extent than it would be if the plant were not pruned, and that the largest amount of fruit can be obtained in the shortest time. The amount of fruit occurring in a single axil is also greater. We have seen crops which would produce in a large number of instances as many as half a dozen cucumbers in a single axil. From our experience, it would seem that a plant pruned would produce more fruit than one not pruned, or, in other words, the pruning increases the yield; as in the two experiments noted there was a larger yield obtained from the pruned plants, although the crops were grown on successive years, and hence not under exactly similar conditions.

Cucumber Diseases.

Both indoor and outdoor cucumbers are subject to a number of diseases. Many of these troubles are directly traceable to the gardener; or, in other words, diseased conditions of the plant are brought about by a lack of knowledge and skill in handling the crop. This particularly holds true where cucumbers are grown under glass, in which case the gardener to a large extent is responsible for the plant's environment. The gardener who grows outdoor cucumbers must submit largely to conditions and circumstances which he cannot control, although it is possible under these circumstances for one to modify to some extent the conditions of his crops to better meet these adverse external influences. Cultivation of outdoor cucumbers has met with many drawbacks during the last few years, and the same holds true in regard to the melon industry. This condition of affairs is mostly caused by the presence of certain fungi that attack the foliage. Experience has shown that the use of ordinary fungicides and the application of the common methods of spraying have little control over these pests. The most serious fungous diseases affecting outdoor cucumbers at the present time are those caused by the anthracnose and downy mildew, and bacterial wilt is more or less prevalent. Indeed, the ravages caused by the presence of the fungus known as

the anthracnose are so great that it is a question at the present time whether it is worth while to attempt to raise cucumbers and melons out of doors, or at least not until some more efficient methods have been discovered than those utilized at present.

Some of the principal diseases with which cucumbers are affected are as follows: —

POWDERY MILDEW (*Erysiphe Polygoni* DC.). — This is a white, mildew-like growth, which occurs on the upper surface of the leaves, and is not uncommonly seen on cucumbers grown under glass. It occurs most frequently in houses which are kept too moist and dark, and which lack ventilation. The most successful method of preventing mildew is to give the house air and light, and hold the moisture down. This results in producing a crop possessed of firm texture, which will be less susceptible to mildew. In case the mildew has become once established in the house, through some mismanagement of the crop, the plants can be sprayed with ivory soap and water, mixed at the rate of one bar of ivory soap (10-cent size) to 15 gallons of warm water. This should be applied when first made, and when warm. Bees constitute the most active agent in the spread of mildew. If a few leaves become infected in the house when the bees are active, it does not take a great while for them to infect the whole crop. Care should be taken in such cases to destroy the first signs of mildew as it appears.

TIMBER ROT (*Schlerotinia Libertiana* Fckl.). — This disease is common to both cucumbers and tomatoes. It attacks the stem, causing a shrivelled, dry and lifeless appearance of that portion affected. Black masses, or sclerotia, which are about one thirty-second to three-sixteenths inch in diameter, appear on the surface of the affected region. These will germinate and infect other plants, if the conditions are favorable. The fungus which produces the timber rot is confined to the soil, and is supposed to be the same as that which causes the so-called "drop" in lettuce. It does not, however, cause very much damage to cucumbers and tomatoes, as a rule. Should it ever become serious, the only remedy to apply will be to sterilize the soil. Under

the most favorable conditions this method of treatment can be applied at a low cost at the present time, and, when thoroughly done, it constitutes an absolutely positive remedy for this and other diseases that have their origin in the soil.

Damping off (*Pythium De Baryanum* Hesse.). — Seedling cucumbers very frequently damp off when placed under unfavorable conditions. The principal unfavorable conditions which give rise to damping off are lack of light, too close planting, too much heat and moisture, — or, in fact, anything which tends to produce weak, spindling seedlings. For this troublesome disease the method of prevention is obvious, viz., to eliminate the conditions which favor the growth of the fungus. Damping off almost invariably occurs on seedlings, and seldom affects plants which have developed a leader five or six inches long. If it is necessary to force seedlings, or place them under conditions which favor the development of the damping fungus, a positive prevention can be had in sterilizing the soil. Since the amount of soil which is necessary to start many hundreds of seedlings is small, this method of treatment can be applied at an insignificant cost, and, besides acting as an efficient remedy for damping off, the germination of the seed and development of the plant will be greatly accelerated.

Downy Mildew (*Plasmopara Cubensis* (B. & C.) Humphrey). — This mildew made its appearance for the first time in Massachusetts in 1890, and it was not observed again until 1899. Since this latter date it has been present each year in both indoor and outdoor cucumbers and melons. It does the most damage, however, to outdoor crops of cucumbers and melons. There is something peculiar in the history of this mildew, as it is not known positively where it originated, nor why it should appear so suddenly over a wide area. The mildew can be seen on the under side of the leaves, and its identification can best be established, with the naked eye, by the characteristic small whitish or yellow angular spots which occur on the leaves. Its occurrence on greenhouse plants is not, however, of serious consequence, as it appears only on crops that are planted early,

and no record of its appearance later than December is known in this State. We have never known indoor cucumbers started in October or November to be affected with this fungus, but those started in August or September are likely to be. From this it appears that greenhouse crops started in August or September become affected from outdoor crops, as this is the time the mildew is prevalent on outdoor cucumbers. This mildew can be completely controlled by spraying with Bordeaux mixture every two weeks; but for indoor cucumbers it would be better to plant them in October or November, rather than earlier, as there is little likelihood of these becoming infected.

ANTHRACNOSE (*Colletotrichum Lagenarium* (Pass.) Ell. & Hals.). — At the present time this fungus causes more trouble to outdoor cucumbers and melons than all other organisms combined. The attack has been so severe in some instances that it is almost impossible to succeed in raising a crop without having it all destroyed before maturing the fruit. The first indications of anthracnose are yellow spots on the leaves, which multiply and enlarge, and in a very short time the whole plant succumbs. The spread of the disease is frequently so rapid that it only requires a few days for the entire crop to die. Crops killed by this fungus present a dry, parched aspect, as if they had been subjected to hot and dry winds of the greatest intensity. Greenhouse cucumbers are also affected with anthracnose in the spring of the year. We have, however, never observed this fungus on indoor crops earlier than March 24. The anthracnose does not appear so destructive in the greenhouses as out of doors; at least, greenhouse cucumbers will continue to live some time after being infected with this fungus. All of the experiments made in spraying for the control of the anthracnose have been very discouraging. About all that can be said at the present time is that vines thoroughly sprayed every one or two weeks will remain green slightly longer than those not sprayed. During the season of 1901 it caused an immense amount of damage to melons, making its appearance during the latter part of July in this State.

BACTERIA WILT. — Many cucumbers grown out of doors

frequently become wilted. It is caused in many cases by bacteria, which multiply so rapidly in the plant as to clog up the vessels. Since there are certain worms which affect the roots and stems of cucumbers that also cause wilting and subsequent collapse of the plant, care must be taken to distinguish between these two troubles. If the wilting is caused by worms, an examination of the roots will show their presence: whereas, if caused by bacteria, the roots may appear perfectly healthy. If the wilt is caused by bacteria, sections of the leaf petiole about one inch long, placed under a tumbler, or in any moist place, will exude a mucilaginous material from their ends. This constitutes a rough method of diagnosing the disease, the exudation being caused by the bacteria multiplying so rapidly in the tissues that they are forced out. No effective remedy is known for the bacterial wilt at the present time.

Other Troubles. — Some other difficulties which growers of greenhouse cucumbers have to contend with are caused by organisms belonging to the animal kingdom, such as aphis, thrips and nematode or gall-forming worms. Fumigation with tobacco is the general method of treatment employed for the two former pests, while freezing or sterilizing the soil constitutes efficient remedies for the extermination of nematode worms.

IMPROVEMENT OF PASTURES.*

BY PROF. J. W. SANBORN OF GILMANTON, N. H.

The older members of a generation of farmers now passing away tell us that New England pastures have greatly deteriorated in their day; that in their earlier days cattle grew more rapidly at pasture than now, fattened into finished beef, and that the profits of beef production depended largely upon pasture feed. At present, on the average pasture, by dint of hard work stock may make a short growth, and on the better class of pastures a low grade of beef. Pastures have ceased to be the measure of the profits on animal products, and cannot be associated with successful intensive methods in animal husbandry. It is a prerequisite of such husbandry than an abundance of palatable and nutritious food be supplied. Three to four fold the area is required that should be to fittingly pasture a fatting steer, while the herbage is neither as palatable nor as nutritious as it should be. Weeds and brakes divide the annual supply of plant food and shade the grass. It is found that such grass, or shade-grown grass, contains more moisture and inorganic protein materials, and is less palatable than the grass of the open, under the full influence of the sun's rays.

The fact that the dense, rich mat of grass of our early pastures has given place to bushes and weeds is evidence of change and deterioration. Sir John B. Lawes changed the ratio of the several grasses and clovers and even the per cent of weeds by varying the chemicals applied. On plats of grass treated for several years to dissimilar chemicals I found timothy preponderating on some, clover on others

* Supplementary to lecture on "Beef Production in New England."

and white top on others. On my grass plats this year on which no nitrogen had been applied with the minerals for years golden rod was abundant, while the plat having a half ration of nitrogen contained some of this weed, but none was found in the section where nitrogen was used in full formula. The record of the decline of our pastures is read on their face. Weeds, bushes and change in character of grasses tell us of a century's flow of nitrogen, lime and phosphoric acid from the soil, and in their character tell us, too, that these have not gone in proportionate amounts.

Where 1,000 pounds of beef are removed from the pastures, there go 1.8 pounds of potash, 25.2 pounds of nitrogen, 19.2 pounds of phosphoric acid and 21.4 pounds of lime. As potash is much more abundant in the soil than phosphoric acid, it will be seen that selling beef is selling out of the pasture phosphoric acid in greatly undue ratio, while lime and nitrogen go at a good pace.

The sale of milk, too, is a sale of the phosphate of our soils in ratio to total supply faster than potash, — 1,000 pounds containing 5.3 pounds of nitrogen, 1.9 pounds of phosphoric acid and 1.8 pounds of potash. Here, however, it is nitrogen that is taken in largest amount, the material that grasses find it most difficult to obtain.

Pastures Dead Property.

This drain of phosphates and change of herbage have left so little of easily available and palatable foods that animals will not eat excess food enough for a growth yielding economic results. Growth has been reduced per season to from 150 to 175 pounds, and on the best pastures 200 pounds. Such growth has involved so much of labor that cattle will consume only little more than food of maintenance rather than endure more strain in securing food. The growth obtained must go into the class of low-selling beef, with the result that the revenue will not average over $1.20 to $1.40 per acre, — little more than taxes and care of pasture. Indeed, we should be better off without them, as dependence upon them compels the sale of a lower grade of beef than can possibly yield a profit, and compels us to winter stock

once or twice too often, thus lengthening the period during which maintenance rations must be fed, thereby absorbing all or more than all of the apparent profits of pastures. This view might be set forth by mathematical calculations, yet so many problems are involved that the question may perhaps as well be left for reflection, and to the general knowledge that the old system of wintering stock without growth, or on mere maintenance rations, for the good growth then cheaply made on pastures, is giving way before the fact that our poor pastures no longer compensate for poor barn feeding, and the further fact of no net returns per acre of pasture, nor none from the old system of summer and winter feeding, where the old type of winter feeding for pasture fattening prevails.

It is said that a Lancastershire English pasture will make 500 pounds of growth in a season per acre. Here it will take ten-fold this area on the average pasture. We cannot afford to farm on this level, with large areas of our holdings practically idle. Pasture lands must be put to work, and to good work. Where this is done, there will come with it a great widening of our business.

How can it be done?

The common advice to cut the bushes and weeds is correct so far as it goes, but it only treats the effect of the disease, and not its cause. At best, the process can only enlarge the area of poor soil that is available, and let the sun in on the shaded grass to sweeten it. This work of restricting pastures to grass, as against bushes and weeds, must be done as an initial step. When the soil is handled for grass, and the bushes cut a few times in August and the weeds kept back, grass will gain a hold and retain it. The persistent recommendation to seed pastures anew and work the seed in is a temporizing expedient. Seed is not fertility, nor can it replace it, and, though successfully started, will not long hold the soil, as against the grass to which the soil has become adapted for reasons already noted. The thoughtless advice to burn over the pasture in the fall and spring fails to note the burning of the nitrogen compounds and the

wastage into the air, and, however carefully done, the injury to roots. Some unwanted seeds or annuals may be injured, but the conditions that breed or harbor them are left. Fertility, and fertility of the right sort, must characterize a good soil. Plants can not make uniform vigorous growth without abundance of proper food.

How to fertilize.

Plant food may be applied in yard manure, and, if accompanied by new and right seed and with a surface cleared of weeds, will give in time a good mat of pasture grass. The process will fall within common knowledge. As all or approximately all New England farmers are hard taxed to obtain manure enough for their fields, this method may as well be passed by, at the present stage of pasture development.

Grain feeding on pastures, with partial reference to improving them, is an English custom. Sir John B. Lawes has shown by trials that such pastures when turned for staple crops are more productive than those not thus treated. Trials by the writer in Missouri and New Hampshire, and by the experiment stations of Illinois, New York and other States, have not shown a direct compensation in growth or in milk for grain fed to steers or cows during the best months of grazing. It is assumed by many competent authorities that the increased vigor of animals thus fed will in the end place the balance sheet on the right side of grain feeding at pastures. This, I must grant, is an unsolved problem from the purely mathematical side. But when the whole problem is viewed in its relation to soil fertility, or increased yield of crops, and ease of securing daily food, palatability and nutritive value of food and sale value of beef are considered, the balance, it appears, must be on the right side. I say appears, for the whole question is as yet not worked out, and definite figures cannot be given; but its end may be and should be as follows: on one side, an acre carrying a steer and producing 300 to 350 pounds growth salable at top prices; and on the other, four to six acres producing but little over one-half this growth, that must sell in a second or third class market. The process

is, however, a slow one for our times and necessities, but a worthy one. It betters the conditions of pastures that we desire to make good or to gradually improve. It moves in the right direction.

Chemical Fertilizers.

I have a field on top of a ridge, where it receives neither washings nor seepage, bearing its twenty-eighth crop since yard manuring and twenty-fourth crop continuously to chemicals. It is now carrying evidence that chemicals act as direct plant food and not as stimulants, and that they are adequate plant food for long periods and probably for generations. By their use immediate results are secured. I have a two-acre pasture, treated to chemicals three times, through which 80 cows pass to the main pasture, but never until it is grazed over. To it they return after passing to the brook and drinking. I have sown strips of chemicals through grazing lots, and on such strips the cows soon congregate. These strips give more and sweeter grass, and, it is believed, more effective grass.

The quantity annually required is not large after the first good growth is secured. There are taken off in 2,000 pounds of milk but 10.6 pounds of nitrogen; but, as the annual nitrogen supply brought to pastures by rains may be about half this amount, and as probably more is secured by other processes, and as at least half the food taken by a cow is voided in the pasture, the annual deficit may be covered by from 3 to 5 pounds, if, indeed, there is a deficit of this material. However, there are or may be leachings from the soil in small amounts. Only 3.8 pounds of potash pass off in 2,000 pounds of milk, — an amount that on granite soils may be largely supplied by soil decomposition. The phosphoric acid is of more importance, although but 3.6 pounds are found in 2,000 pounds of milk. Phosphoric acid is very hard of solution, is in meagre amount in the soil, and in practice found very pronouncedly effective when applied. In previous data given it was seen that steers take this material away very liberally. It is associated with lime, and is the basis of bone structure.

After calculating the fertilizer supply of grazing stock left as voidings, the annual deficit may be supplied and probably more than supplied by 15 to 20 pounds nitrate of soda, 3 to 4 pounds muriate of potash and 15 pounds of acid phosphate, containing 14 per cent of phosphoric acid. The whole should not cost more than 55 to 60 cents. But no practical man would begin their use with but 33 pounds of chemicals annually. I named 500 pounds annually in the July crop report, with an annual reduction thereafter; 125 to 150 pounds annually would give marked results, — would double the grazing value of an acre in a brief period. I named large amounts in the July crop report for intensive work, and no doubt more than most will care to venture to use. On rough pastures, where the spreading must be by hand, a larger quantity, answering for several years, may be used, in which case more insoluble forms than those above named will be required. Tankage supplemented by ashes, or by 14 pounds muriate of potash to 100 pounds tankage, would make an advantageous fertilizer. Bone meal is an old and tried pasture specific. For steer grazing, as little potash is withdrawn by them, this would answer alone for good pasture, but not for maximum results, nor would it do so well for cow pasture without blood or nitrate of soda annually. The influence of half a ton of tankage or bone meal would be seen for years. It is, of course, understood that a cleared pasture, and, in the absence of the right sort of grass, new seed, are to be secured. It is of considerable importance to the dairy farmer that the increased growth of pasture grass aids the fields. The droppings in the barn or yard at night are increased, and pass to the fields. It should also be noted that chemicals may be better adapted to pasture fertilization than yard manure, especially where steers graze, from the fact that any proportion of nitrogen, potash or phosphoric acid may be used. Steer pasture needs little but phosphoric acid, and for these, where heavy applications are made, bone meal will answer fairly well for a few years. Some nitrate of soda or blood would be needed as the years pass by.

Chemicals and Barn Feeding.

The combination of barn feeding as a source of pasture fertility with chemical fertilization presents some points of advantage. It is often asked, How are we to keep the bushes and weeds back after cutting? While continuous August cutting will soon kill bushes, it is an advantage to gain the assistance of stock. Where stock is partly fed at the barn, they are more likely to crop lower the green things at pasture and to hold bushes back. The chemicals rightly used call out the grasses, and these crowd closer the weeds, while an overstocked pasture is certain to have its weeds closer fed. Chemical fertilization will soon show a pasture of clean grass sward, and quicker, if animals are barn fed in part. In my own practice all pastures available for fields have been taken in for plowing, and I am compelled to barn feed in part. I find an advantage in this system, as in some trials it appeared that a fodder of dry matter daily was advantageous to grazing stock. Theoretically, a cow or steer is obliged to take in more water than is required if enough grass of 75 per cent water is taken to furnish all the nutrition required, — 110 to 120 pounds of grass being required. In cool days in early spring and in the fall or late summer there would be a material excess of water to vaporize and throw off the body. This requires food to do it. It is not a vital point, yet one of the lesser economic questions involved.

Rotation with Fields.

I am pressing all the available pasture ground and woodland not essential to the farm into fields, and in an eight years' rotation assigning one year for pasturage. By this system one-eighth of the tillage area is always in pasture, — and in good pasture, as it is manured the year before grazing, indeed, every year.

This system has an advantage over fertilizing an old pasture, in that new and vigorous plants are fed that are responsive. Also, aeration and decomposition of soil by the process of aeration add to the available plant food of

the soil. Nitrogen accumulates under a grass sward, and so closes the soil to atmospheric agencies that the process of decomposition becomes very slow. Grass sward then gains less for its annual use through nature than tillage land. The turning of such a sward helps other crops to plant food, and through the solution of the elements of plant food a soil opened and tilled is itself aided. In any good rotation more plant food is taken from land than would be the case if the ground was occupied by grass. These assertions, stated dogmatically, rest upon well-taken data, all of which cannot be crowded into a brief paper. A good rotation in the hands of a good farmer should average three tons to the acre, — an adequate amount to feed a cow and a half for a pasture season of five months. By it more cows can be kept than by the pasture system under chemical fertilization. In accordance with previous suggestions, I pasture one-eighth the tillage lands, and use a part of the tillage crops to supplement the untillable pasture areas, feeding as dry food at barn.

The system has an apparent defect. It uses this area but one year, and follows timothy grown as a sale crop. Timothy is said not to make a good grazing grass, on account of its bulbous enlargement at the base of the stem, liable to injury by grazing and trampling, and to its disinclination to throw up a good second crop or to grow after cutting. But grazing deals with the young plant, and not one that has matured a hard stem. With me, the system works very well. Others will raise the question of the vital importance of mixed grasses in grazing, and insist on soiling as a substitute for grazing. The first point is considered below, while of the second it is enough to state that I am dealing with grazing improved areas. However, it may be said that soiling has its drawbacks of a serious nature, and has as yet met the approval of but a mere fraction of farmers after many years of debate and use. At best it is but a debatable system, and one that I have not deemed best to incorporate to any material degree in my farm policy.

Grasses for Pastures.

It is an old and insistent contention of authorities that a mixed grass sward yields more and better food than a single grass can. The varieties root differently, mature their grasses at different times, are some of them best in dry seasons, others in wet seasons, differ in composition, digestibility and palatableness, and form a sort of rotation when mixed. The reasoning is logical and cogent on the face of it, yet may have an exaggerated importance. It costs more to seed mixed grasses, by a heavy margin; and, while a mixed grass sward carries more plants to the acre, it must be remembered that great yielders if mixed with lesser sorts may have their number of plants per acre reduced, and possibly thereby to this extent the yield reduced.

But an abstract reasoning is an unsafe guide of action. I made in Utah a trial of nine varieties of grass and clover, and all of these mixed. These were sown on measured acres, fenced, and grazed separately at the same time by weighed steers of equal age and similar weights. Two steers were fed on a half acre each lot until the grass was used up. The ground was naturally poor and rather overstocked. The gain per steer per day for each kind of grass as the average of two years' trial was as follows: —

	Pounds.
English rye grass,	.78
Orchard grass,	1.24
Tall oat grass,	1.73
Meadow fescue,	1.25
Timothy,	1.42
Meadow foxtail,	loss.
Kentucky blue grass,	.87
Red top,	.47
Lucerne or alfalfa,	1.39
Mixture of above varieties,	2.20

The above kinds included the great producing sorts and the most popular kinds for grazing. The point of chief importance is that the most productive kinds gave the best results, although they are not classed as the best grazing sorts. Timothy made a good showing for a grass that has

stood theoretically at the foot in popular opinion as a grazing grass. The mixture for the two years' trial justifies popular views, yet it is seen that a single kind may give good results. I would caution the reader against drawing final conclusions, and especially from assuming that tall oat grass is the best grazing variety. It is, however, a grass that sends up a second crop quickly and vigorously, being a heavy yielder.

One sowing down for pasturage to remain a few years should not hesitate in using mixtures. My experience with varieties leads me to advise the use of the great yielders in the table above, excluding English rye grass, Kentucky blue grass on our granite soils, meadow foxtail unless for moist soils, and alfalfa unless for soils with open subsoils and limestone origin. Red top and Rhode Island bent grass may be included for New England soils, especially if a little moist. In reseeding a rough pasture, to remain permanent for grazing, it is common to use a spike-toothed or a smoothing harrow when the soil is moist in the spring, or in wet times in early fall. Mixtures for such a pasture, or one intended for a few years' use, include white clover and often red clover. Red clover is a biennial, and of course soon dies out. Alsike clover is a perennial, and holds well to the soil, standing our winters well.

It is common to give tables of the amounts of each kind to be sown per acre, and to sow heavily. Whatever the ratio of the mixture, the proportion will soon vary from the original to adjust itself to environment, soil, fertilization and even to seasons.

It is common in the western States, or especially in the southern belt of western States, to hold some pasture area unfed, or practically unfed, until fall, or even well along towards winter, and to save some grass over for an early spring bite. Under some conditions this is not a bad practice. By this practice, or by understocking, cattle can be grazed later in the fall and earlier in the spring. In intensive farming this may not be the best method, but under some conditions it is advantageous. My earliest beef has been made in a pasture where a heavy growth was left over

and utilized for an April pasture. The mixture of the green grass of spring with that wintered over kept the bowels in good order, and growth was continuous from the start.

Where Kentucky blue grass thrives, it makes the best of winter grass. I have seen it under snow, green and inviting to cattle. On places to which it is adapted, it should be sown for late and early grazing.

In recapitulation, as at present advised I would clear all pasture ground incapable of tillage of weeds and bushes, sow the ground to mixed varieties of grass seed and to chemicals, and at least for a time partly barn feed. All land suitable for tillage should be taken into a rotation with fields, and made very productive.

Other and less effective systems may be adopted, some of them incorporated as partial modifications of either of the above systems. It is imperative that some system of improvement that is comparatively quick in action be taken up at once.

SPECIAL REPORT

ON

TREE SURGERY.

BY

EDWARD HOWE FORBUSH.

Prepared under the Direction of the Massachusetts State Board of Agriculture.

TREE SURGERY.

BY EDWARD H. FORBUSH, WAREHAM, ORNITHOLOGIST TO THE BOARD.

When work on the gypsy moth was begun, by the State Board of Agriculture, in 1891, it became necessary to cut from the trees many decaying limbs, for the cavities in such limbs, or the loosened bark upon them, harbored the moth. It being desirable, so far as possible, to prevent injury to trees such as commonly follows such operations, experts were consulted, and available literature was searched, with a view of learning: —

1. The best manner of removing limbs.
2. The best manner of treating resulting wounds.
3. The best season to perform such operations.
4. The time required to heal wounds of different sizes.
5. How large can wounds be safely made.
6. What treatment, if any, will assist trees in healing wounds.

DesCars' work on pruning answered the first query fully and some of the others partially, yet left much to be learned, especially in regard to fruit trees.*

The search made through available literature disclosed the fact that statements made by different writers were often contradictory, and that in many if not in most cases their conclusions were not based on the results of exhaustive experiments. A very few investigators had published valuable results, but their work had been too limited in its scope to furnish all the information required.

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* A. DesCars, "A treatise on pruning, forest and ornamental trees." Edited by Charles S. Sargent, Boston, 1881. Mr. Francis H. Appleton, at the time a member of the gypsy moth committee, secured from the Massachusetts Society for Promoting Agriculture several copies of this work, which were distributed to the superintendents in charge of the various divisions of gypsy moth work.

Wrongly directed, a man with saw or axe can do a tremendous amount of injury to trees in a week's work. He may do such injury even when apparently following the most approved methods. He may amputate large limbs carefully from an old tree and treat the wounds in the most approved manner, only to find that the tree soon dies, apparently as a result of the operation.

Realizing the possible injury that might be done in this work, and desiring that the best pruning practice should be followed by the agents of the Board, both on public domain and on the lands of private owners, the directors of the work ordered a series of experiments to be carried out upon fruit and shade trees of different species. The work of each gang of men in the field during the pruning season furnished unlimited opportunity for investigating this subject; and it was not until 1895 that the questions still unsolved seemed to warrant the detailing of a man to make a series of experiments and observations, with a view to settling fully some of the questions then unanswered. These experiments were carried on until 1900, when the work on the gypsy moth was given up. These experiments have been supplemented by my own observations during ten years, and also by notes made in the spring of the present year (1902) in the district infested by the gypsy moth.

It is not intended to write here an extended and general treatise on tree pruning, for others better qualified for such a task have written on the subject since our investigations were begun.* The province of this paper is to deal mainly with the answers to queries indicated above, as furnished by our investigations, adding thereto such incidental information as may seem pertinent or useful.

No records of the number of trees pruned were kept prior to 1893. In that year 1,906 were trimmed, and the number increased year by year, until, in 1898, 175,629 trees were operated upon. From 1893 to 1899 inclusive more than

* See "The pruning book," L. H. Bailey, 1899. Professor Bailey began his experiments to determine the best season for making wounds and the best dressing for covering them in 1891, at about the same time the writer began experimenting for the same purpose. He has given the results in the excellent work noted above.

484,000 trees were pruned. The field for observation was limited, therefore, mainly by the capacity of the observer. The special series of experiments above referred to consist of more than five hundred operations, the results of which were watched and the records kept by Mr. F. H. Mosher. These amputations were quite evenly divided between fruit, forest and ornamental trees. Among fruit trees, the apple predominates, the pear and cherry being next in number. Among the forest trees, the elms, maples, birches, oaks and ash predominate, followed by hickories or walnuts, and various ornamental trees. Coniferous trees were also included, as the white pine, red cedar, spruce, etc. Records were kept of the age and condition of each tree at the time of the operation, together with its average annual growth. The soil was described, the position in regard to shelter, the exposure, and any other facts of interest, as the condition of the limb when amputated. The size of each wound at the time of the operation was given. The tree in each case was drawn sufficiently to show the nature and position of the wounds, and a yearly record was kept of the healing. This was done both by drawings and measurements, it being stated in each case in which months, if any, growth was made. These examples were not all taken from a limited locality, but were somewhat widely scattered through the towns and cities in the infested district, Somerville, Cambridge, Brookline, Everett, Chelsea, Malden and Medford being chiefly represented.

With this exposition of the opportunities enjoyed for observation, and this recital of the manner of obtaining the data from which this paper is made up, we will pass to a brief consideration of that without some knowledge of which no pruning can be done intelligently.

The Manner of the Tree's Growth.

It is now believed that the roots absorb water from the soil together with material for building up the tree, all of which passes upward through the trunk, limbs and twigs to the leaves, where water is evaporated and carbonic acid gas is absorbed from the air. This upward current is strongest

in most trees during the spring months, when the buds swell and the leaves grow.

The sap, having been elaborated by the leaves, is returned from them and passes toward the roots through the soft cells of the inner bark, forming in its progress earthward the new wood and bark. There is a tissue called the cambium lying upon the outside of the wood, but beneath the bark proper. From the inner surface of this tissue the new wood seems to grow, while on its outer surface the bark is formed. As the new wood is deposited outside the old wood and just beneath the cambium, vigorous trees thus add each year a new annual cylinder or ring of wood to trunk and limb. This we call the annual wood ring. Our observations show that, so far as the trunk and larger limbs are concerned, this growth occurs mainly in July and August. Some trees make a vigorous wood growth in both these months, some begin this growth in June, while a few continue it well into September. The growth of wood seems to be greatest nearest the leaves, where it is manifested in elongation of the shoots which begin growth earlier in the season than the trunk or larger limbs. This wood growth is likely to be more rapid with young trees than with older ones.

How the Tree Wounds heal.

Look at the end of a stick of firewood, and you will see the lines (generally irregularly circular, and always concentric) which mark the annual wood rings. Note that it is this annual growth that alone must be depended upon to cover with new wood and bark all wounds upon the trunk or larger limbs made by the amputation of branches.

If a wound is made in the outer bark, and only a portion of this bark is removed, it is replaced by the formation of new cells from the inner bark: but any wound which exposes or penetrates the wood is healed by growth from the cambium, for the wood itself has no power to produce more wood. Its cells soon become lifeless, and its surface when exposed to the air is subject to the influences of decay.

If we cut off a limb, then, the wood cannot heal the wound: in fact, a wound so made can never really heal, in

the sense that a flesh wound heals. When the limb is cut off, its base remains a dead stump on the trunk, awaiting the action of decay to destroy it. Here, then, is the first and chief danger to which the tree is exposed by pruning. Every wound made by cutting off a branch or limb exposes the trunk to the danger of decay.

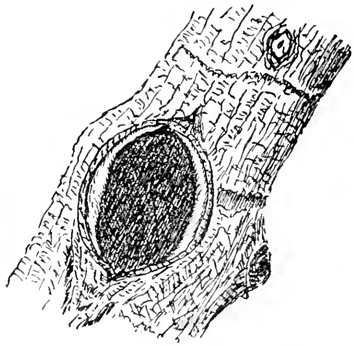

FIG. 1.—Wound made by removing a large branch from a tree trunk. This wound is healing from the sides.

Now, if this dead stump can be hermetically sealed up, and covered over with live, sound wood and bark before it has begun to decay, the chief danger arising from its exposure will have been averted; and this is just what, under favorable conditions, the tree normally does. If the wound is made in winter or spring, no progress in covering it can be made by the tree until the elaborated sap returns in the following summer. Around the edges of a properly made wound the wood-forming material finds no impediment to its flow. As the pressure of the bark upon the sides of the wound has been somewhat lessened by cutting away the limb and by the subsequent drying out of the wood and bark, where the cut surface of each is exposed to the weather, the new wood and bark roll out over the surface of the wound in a mass, which we call the callus.

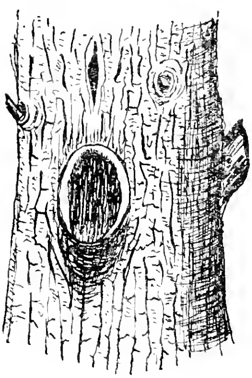

FIG. 2.—Branch wound healing from top and sides.

Wounds that are elongated vertically usually begin healing first from the sides, as seen in Fig. 1, the pressure of the bark on the cambium in such cases being much less at the sides than at the top or bottom. The callus usually forms at the top before it appears at the bottom, so that many wounds begin healing as

in Fig. 2. One reason that healing usually begins last at the bottom of the wound is, that in the operation of pruning the cambium is oftenest injured there. Where nearly circular wounds are skilfully made, in vigorous trees, the callus may come readily from all sides of the wound, healing as in Fig. 3. Of 206 wounds made in 1895, 103 had healed in 1898 on the sides only, 41 had healed all around, 39 on the top and sides only, 3 on the top and one side, 2 at the bottom and both sides, and 1 at the top only.

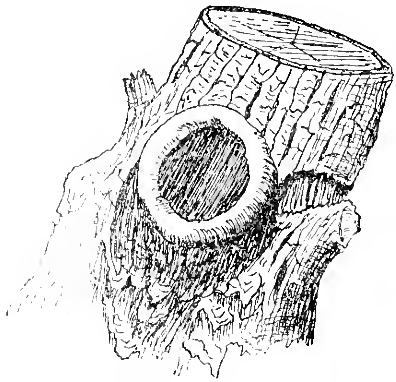

Fig. 3.— Branch wound healing well all round.

If healing progresses only from the sides, it may still cover the wound entirely in time, although it will take years, if the wound is not too large. When the callus meets in the centre of the wound, it grows together, solidifying over the stump. As the callus grows quite rapidly for the first year or two, small wounds will soon become entirely capped over with new wood and bark, thus perfectly sealed in and protected from decay, as in Fig. 4. This new growth does not attach itself in any way to the surface of the wood. If the wound be large, the callus is likely to be checked in its growth after a year or two by the formation of a rigid bark, which covers it and perhaps prevents further growth.

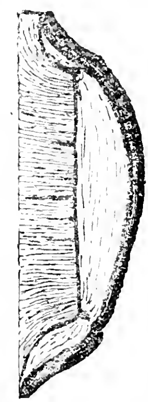

Fig. 4.—Sectional view of healed branch wound, showing covering of new wood and bark.

Nature's Pruning.

As young trees grow, many of the newly formed buds perish in the struggle for existence, leaving only a few of the stronger ones to push out the shoots which will make the future limbs of the tree. In this first thinning, insects play a prominent part, the

"worm i the bud" being responsible for the failure of some; others are destroyed by the elements, others still by birds or other animals. As the young tree continues to grow, many of the young shoots die back. Here again insects take a prominent part in the pruning; twig borers, twig pruners, plant lice, bugs and other insects attack the tender shoots or young foliage, and the tree is able to support only a few of the strongest shoots. The tree, in self-defence, is constantly attempting to produce more shoots than it can mature; and there comes a competition among its members, the weaker being overshadowed and killed out by the stronger. If other trees of about the same age are growing thickly around our young tree, it must compete with them also; for the tree which is outgrown and overshadowed by its fellows, lacking the life-giving light, must surely die. As a thicket of young trees grows rapidly upward, the lower branches are shaded by the tops, die, decay, and finally fall to the ground, leaving the wounds to be healed as best they may. As the limbs are usually small, and rot or break off close to the trunk, the wounds heal readily. Still, in many cases, especially those of resinous coniferous trees, like the white pine, a stump is left which does not entirely decay, but after many years is finally covered by the annual wood growth of the trunk. This process is illustrated by Fig. 5.

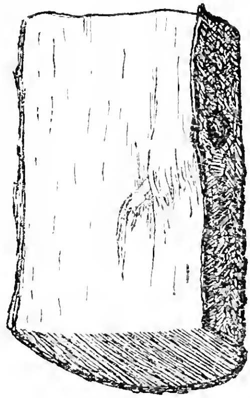

FIG. 5.—Section of pine log, showing depth to which knots penetrate.

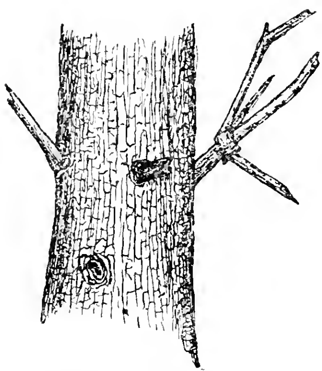

FIG. 6.—Dead branches on pine trunk, the origin of black knots in the timber.

Such stumps, blackened, weather-stained, and perhaps partially decayed, are found in the trunks of most pines,

where, even if covered by the wood of the trunk, they extend from near the heart of the tree almost to its surface, forming the imperfections known as black knots (Fig. 6). If such branches can be removed when the tree is young, the timber formed in the succeeding years will be perfectly clear, so far as knots are concerned.

The breaking down of a limb, as shown in Fig. 7, leaves a seamed and ragged wound, affording a lodgement for water and dust, which soon form a fruitful soil for propagating the organisms of decay. These find ready entrance to the trunk through the cracks and channels of the broken wood. Left to itself, as the years go by, the entire stub

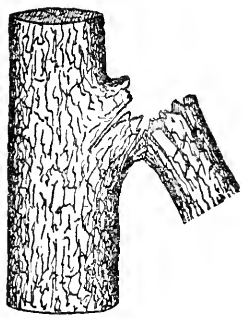

FIG. 7.—Trunk injured by breaking down of large limb.

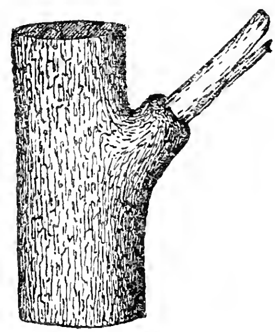

FIG. 8.—Fruitless attempt of a healthy tree to heal over a decaying stub.

rots away, and the disease sinks steadily down into the trunk, until a hollow is formed large enough for the nest of the squirrel or screech owl. Let such a branch as the one shown in Fig. 7 be broken two or three feet from the trunk, and the result may be, in time, the same. We have seen that the elaborated sap which forms new wood and bark, and which alone can heal wounds, comes downward from the leaves. The bare stump, bearing no leaves and having no circulation, has no power of healing its wounds; it must "bleed" and die.* It dies back to the living trunk from whence it sprung. Its bark, being dead, separates from the wood and falls off, leaving a bare stump projecting to the

* Such stumps sometimes send out shoots from latent buds, but in such cases are only imperfectly healed.

weather. If the tree be vigorous, it may make a determined effort to cover this snag with new wood and bark. Such an effort is illustrated in Fig. 8. Here the callus or new growth has been pushed out on the stub for two or three inches. It has already made progress enough to have entirely covered the wound, had the branch been cut off close to the trunk at the time of the accident. If we leave nature to herself, the stub may persist for many years. The bark can never grow over it, as the farther it grows from the main trunk, the farther it gets from the direct flow of the current of elaborated sap supplied by the cambium. Unless the branch rots off, or is broken off again close to the tree, the wound can never heal. One or the other of these alternatives is sure to follow in the course of years; but, even if the wound heals, the trunk of the tree may have become already diseased or even hollow by its intimate connection with the dead branches.

This sort of natural pruning no doubt tends toward the destruction of the weaker trees and the survival of the fittest. In the forest, this is best: but for man, who wishes to cultivate and perpetuate certain characteristics in trees, to follow such a course of pruning, and so destroy his selected trees, is pure folly. Nevertheless, this is precisely what many of us do to-day in this enlightened Commonwealth.

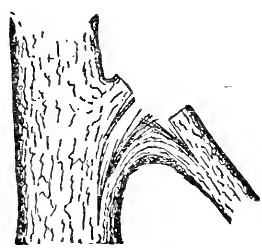

Fig. 9. — Limb breaking down from cut wrongly made.

Poor Pruning.

The citizen, desiring to remove a branch, climbs into the tree and begins to saw downward through the limb at a point from six inches to a foot from the trunk. When the limb becomes so weakened by the saw cut that it can no longer support its branches, its outer end falls to the ground, splintering and tearing the stump which remains, perhaps even tearing a part of the trunk in its fall (Fig. 9). The ragged stump is then left to decay, and begin the destruction of the tree. Some pruners do better than this, by sawing off the

stump about two feet from the tree and then cutting across its diameter near the base, leaving a wound like that shown in Fig. 10. This is an improvement on the first operation, as the stump is shorter; but even in this case the bark on the stump will die, and that on its lower surface, becoming loosened, offers lodgement for the seeds of decay, until, when it finally falls off, decay of the trunk has already commenced. Even if, when hermetically sealed by the healing of the wound, it progresses no farther (as claimed by Hartig), the injury remains in the trunk. The advantage supposed to be secured by cutting across the diameter of the limb near the trunk is that the wound is smaller than if made close to the trunk; but this idea is fallacious, for, as the bark dies back, the surface to be covered by the callus becomes larger than would have been the case if the entire stump had been removed at first. This sort of pruning is one of the main causes of the decay of most of the older orchards of this Commonwealth, where the pruning of our fathers has produced the cavities in which the tree swallows, bluebirds, wrens and flickers now build their nests. There may not be so much danger to young, vigorous trees in this kind of pruning; but trees may be injured, nevertheless, by careless trimming of the head, even in the nursery. I examined carefully to-day (June 1, 1902) two young cherry trees received from the nursery in the spring of 1901, and now dead. These trees had been headed back, and the operator, in each case, had cut from one-half an inch to an inch above a strong bud, in the manner generally approved, as shown in Fig. 11. In each case the bud persisted, forming a small shoot next season; but the tree was unable to

FIG. 10. — Wrong way to remove a branch (cutting across diameter at base).

FIG. 11. — Twig from young tree cut back in nursery.

heal the wound at once, because of the projecting stub, which died back and was attacked by rot at the heart, which has already extended down the limb to a distance of four to six inches. The stubs, at the end of two years, though decayed, still remain to prevent the healing of the wounds, which now appear as in Fig. 12. Here the figure at the left shows the external condition of the stub, while that at the right shows a sectional view. Had these stubs been removed early, and the wounds carefully treated with a wood preservative, this decay might have been prevented. If such stubs are left, who knows how much the decay of several such branches may injure the young tree, or how great and permanent that injury may finally become? It is quite generally believed that decay of trunk and branches induces fruit rot. If there is any foundation for this belief, we cannot guard the young trees too carefully from such injury. No doubt the nurseryman would give as a reason for leaving a stub in pruning, that, if the shoot had been cut off close to the bud, it would have died back, so that the bud would not have started the following spring. It is customary with some gardeners to leave a stub in this manner, removing it in summer after the shoots have started. This plan is no doubt a good one.

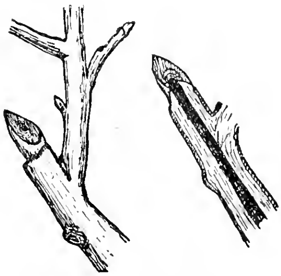

FIG. 12.—The beginning of decay in the young limb.

How to amputate a Limb.

Where large limbs have been broken from fruit or shade trees, prompt action is necessary in removing the stubs and treating the wounds, to prevent decay from penetrating the trunk. If, by reason of neglect or bad pruning, decaying limbs have been left on the trees, similar treatment is required. Owners of trees may need to have such work done, and for their benefit the best methods of repairing these two classes of wounds will be considered here.

Our experience with many thousand trees bears out the practice advocated by DesCars, and stated by Dr. Sargent

in his introduction to the English edition, as follows: "It is necessary to prune in such a manner that no portion of an

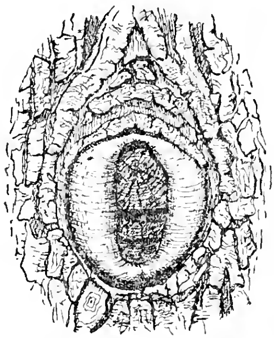

FIG. 13. — Branch wound made with an axe, and now partially healed, but showing horizontal fissures resulting from the axe blows.

amputated or dead branch shall be left on the trunk. The cut should always be made close to and perfectly even with the trunk, without regard to the size of the wound thus made" (see Fig. 14). It has been our practice to follow this rule, except where a large excrescence or "shoulder" projected from the trunk around the base of the limb. In such a case the shoulder has not been cut off, for its removal would expose so large a surface to the weather as to render healing more difficult than if the limb were cut at its base next the shoulder. This method and this alone facilitates the healing of the wound by bringing all its edges in closest contact with the living cambium of the trunk, and thereby making them most accessible to the direct flow of the returning sap which forms the callus, which must cover the wound if it is to be healed. Ordinarily the most practical tool for this purpose is a sharp saw; but it sometimes may be necessary, as in the case of a large limb, to employ the pruning knife or chisel to pare down parts of the base of the limb which the plane or the saw cut may leave in the form of irregular projections on the trunk. Never use an axe, for the danger of injury to the tree is much greater than with saw or knife. The axe not only injures the bark, causing it to die back, but the character of its repeated blows causes the surface of the wound to split, as in Fig. 13. Fig. 14 shows the right way to make the wound.

FIG. 14. — Trunk showing at the left a cut made by removing properly a large limb. On the right a smaller wound, properly made, has already healed.

This seems at first sight a perfectly easy and simple operation, but after one has cut off some limbs and watched the results for a few years, he may conclude that the task is not so simple as it seems. He may find that the bark dries and that its edges separate from the wood immediately about the wound, and also that the cambium dies back for a short distance, thus materially enlarging the space to be covered by the callus. This dying back of the bark is likely to extend more below the wound than on the top and sides. The operator may find that at the end of the first season's growth little if any visible progress in healing over the cut surface has been made, the callus formed having been all used in covering the surface of the wood exposed by the dying back and rolling up of the bark. In a year or two more the bark below the wound may have fallen off, leaving the wound enlarged, as in Fig. 15. Such a condition of trunk wounds is almost certain to follow amputation, unless the work has been done with the utmost skill and care.

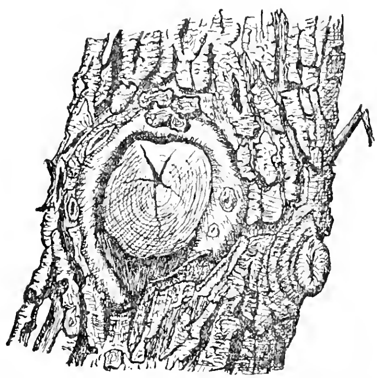

FIG. 15. — Branch wound enlarged by careless amputation and loosening of bark below.

The injury arises from a separation of the bark from the trunk during the operation, or from a crushing and consequent killing of the cambium, both of which are liable to occur in pruning as commonly done.

If the operator, wishing to use due care to prevent breaking down the limb, begins his cut from below, saws part way through the limb and then finishes by sawing to meet the cut from above, the limb, when weakened and about to fall, swings downward, thereby bringing the edges of the lower cut together, and, swinging on them as on a pivot, while still held by the unseparated wood, loosens and crushes the cambium at the lower portion of the wound. All loosened or injured cambium dies. The cambium around

the entire surface of the wound may be loosened even by the friction of the saw in the hands of a careless workman.

Small, short limbs, less than an inch in diameter, if carefully supported while being cut off, may be removed with a single cut by a sharp saw in the hands of a skilful operator; but for all who are pruning large limbs, the method indicated in Fig. 16 is a safer one.

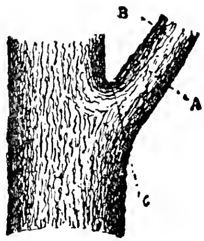

FIG. 16.—Illustrating the proper method of removing large limbs.

The limb is first cut at *a*, the cut extending upward and halfway through. The cut at *b* is next made, and the limb falls, splitting to *a*. If the limb is large, the operator should guard well against being struck by the butt, either in its fall or on the rebound which may come when the outer end of the limb strikes the ground. The limb should then be sawed off at *c*, care being used to support the stump during the operation. Great pains should be taken, when making the last cut, not to start or bruise the cambium. Healing should then begin well. There may be, and usually is, a slight drying out and dying back of the bark at the edge of the wound; but the callus readily pushes forth from under this slightly loosened rim, and begins the work of covering and healing.

THE TREATMENT OF TREE WOUNDS.

We have seen that leafless stumps left upon the tree die back, and so carry disease into the trunk; also, that ragged wounds invite decay. We can see also that any wound on the surface of the tree, however carefully and smoothly made, offers an opening for wound rot, unless protected by a covering which will seal it against the entrance of water and the organisms of decay. Some coniferous trees furnish resinous secretions which, in a measure, protect wounds made on their trunks, but this is not the case with deciduous trees.*

* "When wounds, due to pruning, barking, etc., expose the wood of a dicotyledonous tree, the tree protects itself against the unfavorable influences of the environment in two ways. In the first place, the vessels become completely plugged up by tyloses (tyloses are growths of the cells surrounding a vessel,

When we remove a limb, we cut across the grain of the wood where the branch leaves the tree. Every portion of the wood surface which is thus exposed dies. We know how readily water enters the "sawed-off" end of a dead log, and how wood rot follows. A similar process now takes place in the wound; a dark stain first penetrates the wood, steadily spreading inward from the surface. This works down toward the heart of the tree, and is followed by wound rot. If a living green branch has been removed, the surface of the wound dies and cracks, leaving open channels for the entrance of water and the spores of parasitic fungi. If the branch cut off be already dead, decay may have been communicated to the tree trunk. Such decay begins or is preceded by a discoloration in the first annual ring, close to the heart or "pith" of the branch. This discoloration may extend many feet down and into the trunk, so that when the limb is removed the wound may present an appearance like Fig. 17.

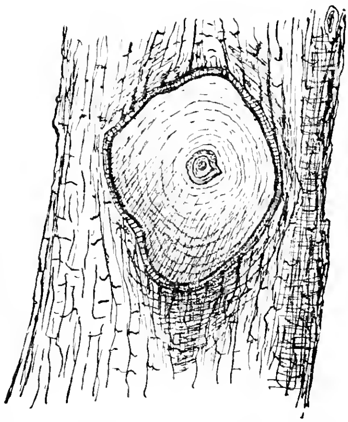

FIG. 17.—Beginning of decay in centre of wound (allowed by delaying amputation too long).

Now, if in either case the wound is very small, it may heal soon enough to prevent serious decay of the trunk, but a large wound certainly will not. The only safe treatment is to cover all wounds on deciduous trees, and the larger ones on coniferous trees, with some fluid substance which in drying and hardening will close the ends of the channels in the wood, and prevent decay until the tree can cover

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which push their way through the pits into the cavity, and may there divide and grow further), which both prevent the entrance of rain water and the evaporation of any water that may be present in these organs. In the second place, gums are formed in abundance in the neighborhood of the wounded surface, and these fill up and close the lumina of the organs, especially the vessels, thereby protecting them, to a certain extent, against prejudicial influences of the environment. . . . The foregoing protective agencies are, however, insufficient to afford absolute security to the exposed wood against decomposition and decay." ("Diseases of trees," by Prof. R. Hartig.)

the wound with new wood and bark. For this purpose a lasting and antiseptic dressing is required. Coal tar was used almost exclusively in the gypsy moth work. It is inexpensive, penetrates the wood, adheres well, lasts well, and its odor is repellant to insects. Large wounds given one coat of coal tar in November, 1895, are, some of them, still (July, 1902) in a fair state of preservation.

The objections to its use are, that it must be warmed in cold weather, that it is more difficult to apply than paint, and that it may injure the bark if applied so as to come in contact with it. DesCars says that coal tar should only be used with caution on the wounds of drupaceous fruits (cherry, peach, plum, etc.); Card states that coal tar seems to have hindered the healing process;* Bailey says that coal tar often injures the cambium and bark of fruit trees;† while Hartig, who experimented mainly with oaks, says, "I have never observed any injurious effect of the tar on tissues;" also, "It is only the ruptured organs and their walls that are penetrated and impregnated by the tar."‡

It is a matter of common observation that tar applied copiously and directly to the bark of fruit trees may cause injury. Some of our observers affirm that if applied on newly formed callus it injures the cells and checks new growth. It should be used, therefore, with care, for its office is to coat the exposed wood, and not the bark. The tar when dry does not injure the callus, which grows over it precisely as it does over unprotected wood.

If green branches, larger than one or two inches in diameter, have been removed, it may become necessary the second year or later to apply another coat of thick tar, to fill any small cracks resulting from the drying of the wood. Then the utmost care should be exercised to keep the fresh tar from touching the ring of callus which has formed about the wound. Thick lead or asbestos paint may be used in place of tar. The only objections to their use are

* "Notes on pruning," Bulletin No. 50, Nebraska Agricultural Experiment Station.

† "The pruning book," L. H. Bailey.

‡ "Diseases of trees," R. Hartig.

that they are more expensive, and do not fill the seams in the wood so well as tar. Lead paint is largely used by orchardists, and is rightly considered superior to shellac or grafting wax for a permanent dressing for wounds. Wounds covered with lead paint should receive two or more coats. The second and third coats should each be put on after the previous coat has hardened and dried thoroughly.

Where wounds do not heal, or heal slowly, the wood must be treated from time to time, and every effort made to prevent decay. Wounds caused by limbs breaking down, or where the bark is torn off by accident, may be smoothed, the decayed wood, if there is any, removed, and the surface of the wood treated with tar or paint. Where hollow limbs are removed from a trunk already hollow, they may be plugged with wood or covered with zinc, and well tarred or painted. This phase of the subject has already been quite fully treated in the report on the gypsy moth,* to which the reader is referred for the methods used. There is nothing to add from later experience. Such expedients will not fully arrest the decay of a tree which has become hollow.

The Best Season for Pruning.

Those who have a personal acquaintance with practical foresters and orchardists will no doubt find quite a diversity of opinion as to the proper time of the year to prune trees. If we turn to the literature on the subject, we shall find an equal difference of opinion, the advocate of each season supporting his claims with arguments satisfactory at least to himself. There are some who believe that the season at which pruning is done has no effect on the result, and who agree with the aged farmer, who said that the best time for pruning was when he "had the time to spare, and sharp tools."

The best season for removing limbs would seem at first sight to be that in which the edges of the wound may soonest become covered with the living tissue, and thus be almost at once protected from the weather. The returning sap is

* "The gypsy moth," Forbush-Fernald, Massachusetts State Board of Agriculture, 1896.

usually most actively employed in building up the wood growth of trunk and branches, and also incidentally healing wounds thereon, in the summer months, although this process may, in some cases, extend into the autumn.

Most wounds do not heal at all in June, and we find records which credit the entire healing to August, while occasionally a good growth will be made in September. Wounds well made in June or July will normally begin healing very soon on most trees, and some old foresters with long experience regard these months as the best time to prune; but there are objections to pruning at this season. Summer pruning is considered to be weakening. It removes new growth and leaf surface which has been made at some expense to the tree, but which, if allowed to remain until fall, would in the mean time return elaborated sap, and do its part toward the upbuilding of the organism which has thus far supported it. Winter pruning removes the branches after the leaves have fulfilled their office and fallen, being therefore more desirable as regards its effect on the strength of the tree.

It is most difficult to prune in early summer without loosening the edge of the bark around the wound, which, as we have already seen, delays the process of healing. Again, the wound will be moist at this season, and the paint or tar used as dressing will not so readily penetrate and adhere; while the moisture of the wound, the separation of the cambium from the wood, and the warmth of the season, all are favorable for the introduction of parasitic forms of life about its edges or upon its surface. It may be well doubted if any but the smallest limbs should be removed at this season, and by the most skilful workmen. The wounds may then be confidently expected to heal quickly and well, and, unless too many branches are removed in one summer, there may be no serious injury to the trees operated on. If we prune in spring, we find the dangers already alluded to increased by a troublesome flow of what may be called "crude sap." As foresters say, the wound "bleeds," wetting not only its surface but also the trunk of the tree, making it impossible for tar or paint to adhere properly, because of

the moisture and the outward pressure of the flow, which forces the dressing off the face of the wound in spots, forming "blisters" beneath the drying paint or tar. This "bleeding" in itself probably does not greatly sap the vitality of the tree, neither does it "poison" the bark below the wound, as has been so frequently asserted; but pruning at this season often loosens and injures the bark beneath the wound, the sap runs into the cavity thus formed between wood and bark, which is kept constantly filled with this watery fluid, which can only induce decay. Another objection urged to spring or summer pruning is that it lets in too much sunlight and heat, thereby inducing sun-scald. But if we propose pruning in autumn or winter, we are met with the objection that the wound may be injured by frost; we must remember, however, that large wounds must withstand the frosts of many winters before they can be healed. Injuries by frost may, and probably do, occur in some regions; but, having examined thousands of wounds in Massachusetts during an experience of ten years, I have never yet seen any injury that I could positively attribute entirely to this cause. The effects of sun, rain and drying winds appear to be more serious than those ordinarily experienced from severe or protracted cold. Having had this matter in mind for years, I am led to the belief that trees may be pruned at any season with safety; but by preference I prune my own trees either in the late fall before the weather becomes too cold to work in comfort, in the late winter, or very early in spring before any growth starts. In winter the whole conformation of the naked tree can be studied much better than in summer when it is covered with foliage. The wounds on most trees at this season are comparatively dry, and there is no "bleeding," therefore the dressing penetrates and adheres well. The bark does not separate readily from the wood in the fall or winter. Still, there are some trees which should not be pruned in late fall or early spring. The American maples are likely to "bleed" if pruned late in the fall, or during warm or moderate weather in the late winter or early spring. These trees can be pruned moderately in July, when the sap no longer flows from the

wounds. The hornbeams and birches "bleed" very freely, and if pruned at all it may be done in summer. Trees of these species pruned in February bled so badly later that the sap forced off portions of the tar dressing which had already become quite dry.

Length of Time required to heal Wounds.

No accurate statement can be made as to the length of time trees require to heal wounds of given sizes. Nevertheless, some interesting data can be given and some average growths indicated. The length of time required to heal a properly made and adequately protected branch wound depends mainly on: —

1. The species operated upon.
2. The age and vigor of the tree.
3. The position of the wound on the tree.
4. The size of the wounds and the number on the tree.

In our experience, wounds on forest or ornamental trees heal much more readily than those on fruit trees. Those healing most rapidly were the common willows and the white ash, both of which made the first year an average growth of callus of over one-half inch from the circumference of the wound toward the centre. At this rate a wound one inch in diameter would heal in one season, but the rate of healing of larger wounds is likely to grow less in the succeeding years.

While young and vigorous trees of most species healed wounds well, healing on old and decayed trees proceeded very slowly, if at all. Mr. Mosher states that the young trees he examined from 1895 to 1899 healed branch wounds, on an average, at the rate of three-quarters of an inch per year; still, the largest wounds that he had seen healed perfectly in that time were not over two inches in diameter. It was found that in seven years certain wounds two to four inches in diameter had healed very well, others on similar trees had healed only a little, while others on trees of the same species had not healed at all. It was often the case that, while certain wounds on a tree were healing well, others on the same tree were not healing at all. Some trees failed to heal

any but the very smallest wounds. Observation and comparison led to the following conclusions: —

1. Wounds on old and decayed trees heal very slowly, for usually these trees are making very little annual growth.

2. Wounds on young, healthy and vigorous trees heal very rapidly.

3. In general, wounds near the leaves heal most readily. Those wounds near the top of the tree or the ends of strong, healthy limbs, where the growth of the wood is most rapid, usually show the greatest annual growth.

4. Wounds near the base of the tree, and therefore farthest from the leaves, heal very slowly.

5. Wounds on the upper side of a limb do not heal at all in many cases. There also the wood is most exposed to the elements, and decays more rapidly than when the wound is made upon the lower surface. Where the face of the wound is nearly level, even if healing begins well, the raised callus growth around the wood may serve to hold the water on the exposed surface of the wood, thus facilitating wound rot.

6. Other things being equal, few and small wounds heal best. Thus we approach the final query, — How many and how large limbs can be safely removed from a tree?

It is well known that foresters and orchardists sometimes remove the entire heads of old trees, leaving only a few small branches or suckers, which shortly form new and vigorous heads. Willow posts set in the ground are known to send out shoots and send down roots, soon forming a new tree. I have even seen willow logs thrown on damp ground take root and send out shoots; but it does not follow from this that harsh and vigorous pruning will generally succeed.

I have never had any experience in heading in old trees, but have not known any wound over four inches in diameter made in general pruning practice to heal in six years. This ought to give the man who casually hacks off limbs eight to twelve inches in diameter something to think about. If we remove such limbs, we can hardly expect the wounds to heal in fifteen or twenty years, if ever. In the mean time, the tar or paint weathers off, and must be renewed. Cracks appear in the wound's surface; these must be kept tightly

filled (a difficult task), if we are to prevent decay. But suppose we succeed in this, and the callus grows well from all sides of the wound, well overlapping the tarred or painted surface of the wood, the callus can never become attached to this dead wound-surface, but merely grows over it, leaving an infinitesimal seam between it and the wood. In fifteen or twenty years the continual "seeping" of water into the seam will convey decay to the dead wood at the bottom of the wound.

Some say that the removal of such branches is simply a matter of skilful surgery; but can they point to one branch wound ten or more inches in diameter that has healed without any trace of rot in the wood? Such wounds should never be made if it can be avoided, for they are almost certain to ruin the trunk, sooner or later. They are permissible only when an accident, like the breaking of a large limb, occurs; when dead or decaying limbs threaten the welfare of the tree; or when it becomes necessary to head back an old tree, to increase its vigor or fruitfulness. In all these cases decay may be deferred, but not prevented.

The removal of large limbs from a tree will lessen its capacity for healing wounds, for it greatly reduces the leaf-bearing members, and thereby the leaf surface, which must, as we have seen, be depended upon for elaborating the sap which is to deposit the materials to form the callus. The larger limbs grow mostly from near the base of the tree, where wounds do not heal so well as at the top.

Another objection to their removal is that it is likely, as we have already seen, to admit too much sunlight, which may result in "sun-scald," weakening the tree and facilitating the attacks of injurious insects.

My observations have led me to believe that no limbs over three to four inches in diameter should be removed from any tree if it can be avoided. A large tree in good health should heal three or four such wounds in six or seven years; some trees may do better than this, while some will not do as well.

A considerable number of small limbs or shoots may be removed from a vigorous tree in winter in such a manner as

to add to, rather than detract from, its usefulness; and if such pruning be annual, comparatively few shoots being removed each year, the tree should be benefited rather than injured thereby. Any number of small dead limbs may be removed at any time from most evergreen or coniferous trees, provided care is taken not to injure the living wood.

The ideal method of pruning is to shape the tree while it is still young and small, and to prune annually at first, taking out such superfluous shoots as can best be spared for the purpose in view while they are still so small that the resulting wounds will heal in one season. If this is faithfully done, the tree will be so shaped and cared for that large branches will not break off, and need never be removed.

To hasten the Healing of Wounds.

Whatever will bring the tree into a vigorous condition and maintain it in that condition will assist it in healing wounds. Fruit trees should be kept well nourished by the application of suitable manures. Where cultivation is possible, it will also help. A heavy dressing of suitable manure, applied in the fall, when the ground is frozen, and extending from the trunk out at least as far as the ends of the branches, will give growth a good start the following spring. Fruit trees which bear heavily annually do not make much growth on the bearing year. No doubt the material that goes into the growth of fruit and seed robs the tree of much vitality and substance, which otherwise would go to making new wood and bark. The modern fruit tree is an abnormal product, perfected in fruit bearing by man's selection, pruning and cultivating for long series of years, and requires the best of treatment, if it is to continue productive and vigorous. If the tree is defoliated by insects, or in any other way, the wood growth will be very small for one or two years.

Of 364 wounds, made in 1895, on trees averaging approximately fifty years of age, 158 had not healed at all three years later. The trees, though old, were in average condition, but they had all borne heavily one year out of three,

and the other two seasons their foliage had been eaten badly by the tent caterpillar and canker worm. Had these trees been sprayed each season, and their fruit thinned when too heavily set, no doubt they would have made some annual growth, especially if they had been kept in a good state of fertility.

Some of the causes which delay the healing of wounds are illustrated by the accompanying figures.

Fig. 18 shows a large wound, 12 by 18 inches, at the base of an apple tree probably eighty years old. This wound was made in November, 1895, and up to July, 1902, it had not healed at all. The age of the tree, the size of the wound,

FIG. 18. — Wound at base of old apple tree. This wound failed to heal at all in six years.

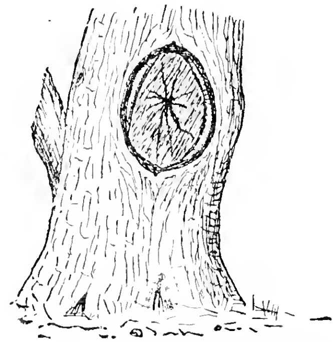

FIG. 19. — This large wound on trunk of apple tree has healed little in six years.

and its situation near the base of the tree, are all strong influences to prevent healing. But the tree is still growing, and, were it not that it still bears fruit in some seasons and is stripped by insects in others, we might expect some healing.

Fig. 19 shows a wound on an apple tree, only about fifty years old. As the wound is smaller than the other, being only 8 by 10 inches, and 4 feet from the ground, it has begun to heal, but in six years has healed only a little at each side, and none at top or bottom. The conditions as regards insects and fruit bearing are about the same as with Fig. 18.

Fig. 20 shows a wound the conditions for the healing of which are still more favorable. It is not a fruit tree, it is younger, being only twenty years old, the wound is higher on the trunk, and smaller, being only 3¾ by 5 inches. It is now nearly healed, but the wood is cracking, and decay will soon begin.

Fig. 21 shows a wound slightly smaller than the last, on a chestnut tree about seventeen years old, which has never borne fruit until the present season. This wound, 15 feet from the ground, has healed entirely in six seasons. Here the conditions were all favorable, the chestnut being a tree

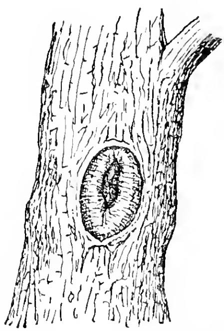

FIG. 20. — Wound ten feet from ground on tree twenty years old, healed considerably in six years.

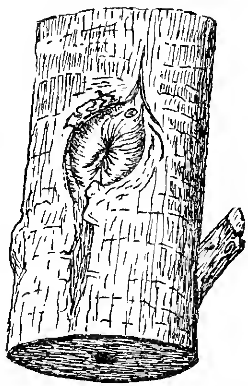

FIG. 21. — Wound fifteen feet from ground on tree seventeen years old, healed entirely in six years.

of rapid growth; but, as the surface of the wound was not dressed when the wound was made, decay of the trunk has already begun.

There is a means of stimulating the growth of trees, the effects of which should be further and more scientifically investigated, and that is, —

Scraping Trees.

Let us consider a moment the bark growth of a tree. We find that bark on young trees or on small limbs is usually smooth, while on large trunks or very large limbs it is commonly seamed, cracked or scaled. As the wood of the trunk or limb grows larger, its growth must exert a

tremendous pressure on the bark which encases it. If the trunk grows, the bark must keep pace with that growth and constantly increase in area.

As the trees grow older and larger and the bark grows thicker year after year, the outer layers die, and, becoming unelastic, crack under the annual pressure caused by the expansion of the trunk, until they finally, as in the case of very old trees, scale off and fall to the ground. When this process is slow, the bark may become so thick and tough as to interfere with the tree's growth.

Scraping orchard trees has been condemned as a pernicious practice, calculated to injure the trees subjected to it. It has been maintained that the rough bark which adorns the trunks and branches of old trees forms, together with the lichens or so-called "moss" upon it, a protection from the blasts of winter, and that the removal of this outer covering must work an injury to the tree. Those who see beauty in the forms and tints of this old bark and its adhering vegetable growths have reason, from an esthetic point of view, to object to its removal. But let it no longer be urged that the process is injurious to the tree. This outer bark is dead tissue, and in many cases it would be better for the health of the tree if it could be removed without waiting for the slow process of nature, by which it is inevitably shed. While it may be some protection from the alternate freezing and thawing of an open winter, its removal very early in the spring benefits the tree. I have frequently asked people who were scraping the outer bark from their apple trees why they did it. They did not know just the reason why, but their usual answer was, "I think it is good for them." Experience has shown this to be true. If the loose outer bark is removed and burned, the harboring places for many injurious insects are disposed of and the insects themselves destroyed. This is the first and most direct benefit of the scraping, but there are others still more important.

In the work on the gypsy moth, it now and then became necessary to remove the rough bark from the trunks of elms, apples, walnuts and some other trees, to prevent the caterpil-

lars from concealing themselves beneath the scales. When this bark was shaved rather closely, it was noticed that in many cases the trees were stimulated to vigorous growth. This growth usually began the second year. With the trees which responded to this treatment the results seemed similar to those caused by manuring and cultivation. Growth began earlier, the leaves grew faster in the spring, were larger and darker, the fruit was larger or more numerous, and the annual wood growth considerably more than on similar trees unscraped. Their trunks and limbs growing better and larger, there was also in some cases a greater flow of callus about the edges of wounds, so that healing progressed more rapidly. The reason for the improved condition of things is not far to seek.

Very many trees become "bark bound." The old dead bark does not shed fast enough and remains upon the tree, pressing upon the circumference of the trunk like a barrel hoop upon the staves, until it becomes so thick and strong as to repress the annual formation of the wood ring and check the growth of the trunk. Release the pressure early in the spring, by either softening the bark, paring it down thin or dividing it by longitudinal slits down the trunk, and the "bark-bound" tree immediately takes advantage of the opportunity that offers for growth and development.

If the tree in its weakened condition has already become infested by bark beetles, the forerunners of death, it may yet be able, with the pressure on its trunk released, to make such a vigorous flow of sap as to destroy the beetles and take a new lease of life. Some trees will not respond to this treatment. In many cases little if any improvement in the healing of wounds was noted. Possibly it may be beneficial only in the case of bark-bound trees. Nor can it be expected to bring the dead to life. An old oak in Winchester, which had been much injured by the attacks of the gypsy moth, was pruned and scraped. Although apparently nearly dead when treatment was begun, it made a most remarkable growth soon afterward, healing over a large bare space where the bark had fallen from the trunk; two years later the tree failed again, and finally died. Its death ap-

peared to be directly due, however, to drastic treatment at the hands of the gardener, rather than to any after-effects of the scraping. From 1893 to 1899, inclusive, 19,304 trees were scraped in the gypsy moth work, and no case of injury from the process has been noted, while the great majority of the trees scraped were benefited. A close watch was kept also on the scraping done by owners of orchards. These people in many cases scraped their trees so severely that only the inner bark and cambium were left on the trunks, which appeared quite white in contrast with unscraped trees. But in most cases the work seemed to benefit the trees, and in no case could any resultant injury be seen. This is much more than can be truthfully said of pruning as generally practised.

Scraping trees has long been practised by foresters having charge of valuable shade trees, as a means of stimulating them to repel the attacks of bark beetles.

This operation is often used, conjointly with "heading back," to reinvigorate old trees, and usually with good results. The bark may be softened at the same time by a good wash of soap suds. To facilitate the healing of a particular wound, local treatment may be worth trying. It was reported to me in 1899 that the raupenleim or insect lime used on some of the larger trees in Malden was injuring the trunks. They were reported as bulging where the lime had been applied. In applying this material to a tree, the outer bark was first scraped off the trunk in such a manner as to form a smooth belt around it. The insect lime was then plastered on to the smooth surface, forming, when finished, a ring of soft, oily substance around the trunk, which would remain viscid for several months.

If the tree was bark bound, and the scraping knife went a little deeper than was necessary for the purpose of merely smoothing the bark, the thinning of the bark, together with the action of the lime as a softener and lubricant, were sufficient to lessen the pressure of the bark on the trunk, which would account for a greater wood growth here than elsewhere.

This is precisely what had occurred. In from three to

five years' time a considerable bulge in the trunk of each tree had appeared, although the trees were not in any way injured. This will suggest at once local treatment for wounds that fail to heal.

Should certain wounds, well situated and properly treated, fail to heal as well as others, let the operator try a rather severe scraping of the bark around the trunk or branch, just where the wound is situated. There is another method which is sometimes helpful. It may happen that the callus forms well around the wound for a year or two, and then seems to stop growth. If its inner edge, where it laps over the face of the wound, is cut away, the cut, by removing the pressure, may cause an increase of callus growth by stimulating the cells to repair the injury.

Trees which stand Pruning well.

It is a safe rule never to do any more pruning than we are obliged to do to protect our trees from injury, to render them productive, or to shape them to our ends. Still, where severe pruning becomes necessary, it is well to know what trees will best bear it.

Of fruit trees, the apple, pear, plum and peach stand pruning well when young or vigorous. Wounds on cherry trees do not heal so readily as on most other fruit trees.

The elm, oak, chestnut, locust and ash withstand pruning quite as well as any of our forest trees. While willows heal wounds very readily, their wood decays quickly and needs double protection. The exposed wood of the birches and poplars also rots quickly. Trees which, on account of bleeding, must be pruned in summer, like the maples, birches and hornbeams, must be treated with care: still, the hornbeams stand pruning well. Trees grown for timber should be planted close together, so that the lower branches may be killed by shade when very small. As the cedars are usually grown for posts, they are seldom pruned.

Negative Results.

So far as can be seen, neither the character of the soil, the slope of the land, the situation, whether exposed or sheltered, nor the exposure of the wound, made the slightest difference in the rate of healing. Wounds made upon the north side of a tree healed equally as well as those made upon the south, east or west, although possibly the wound dried out less rapidly on the north side.

Summary and Conclusion.

1. The best manner of removing limbs is to cut them off close to the trunk or limb from which they spring, using a sharp saw, and taking every precaution to protect the bark around the wound from injury.

2. The best method of treating wounds is to cover them with tar or thick paint. If tar is used, it should not come in contact with the bark.

3. Most trees may be pruned to best advantage in the late fall, late winter or very early spring, before the growth starts; but those which "bleed" in the fall or early spring, like the maples, hornbeams and birches, may be pruned in summer.

4. Wounds not over two inches in diameter should heal in four to six years.

5. No wound larger than three to four inches in diameter should be made on any tree, if it can be avoided. Larger wounds may heal well under favorable conditions, but with unfavorable conditions they may never heal. Wounds on forest or ornamental trees heal better than those on fruit trees. No more limbs should be cut from any tree than is absolutely necessary for the purpose in view.

6. Trees receiving the best treatment, such as manuring and cultivation, those protected from insects and not allowed to overbear, heal wounds better than those not so treated. In some cases, scraping the bark accelerates the healing of wounds.

In concluding this paper, it remains to be said that the time occupied in these observations and experiments was

unfortunately so limited by the discontinuance of the work in 1900 that some questions raised in the mean time cannot be fully answered. The loss of some of the most valuable records of the work of later years has also been a great disadvantage.

The results of pruning trees of different species should be studied for at least ten years more. Cutting, by the owners, of many of the trees under observation, since the cessation of the gypsy moth work, was unfortunate, as it rendered the completion of our observations on these trees impossible. If such experiments could be carried on by a board having entire and permanent control of the trees operated upon, the records obtained would be far more satisfactory. The results of scraping the bark of trees should be further investigated by some one capable of doing the work with scientific accuracy. If carefully conducted experiments on all our shade and fruit trees could be carried out for fifteen or twenty years by the Agricultural College, the results would be far more valuable than those of the necessarily intermittent and incomplete work, some results of which have been briefly given here.

REPORT

OF THE

STATE BOARD OF AGRICULTURE

AS TO THE

FEASIBILITY AND PROBABLE COST OF PRODUCING VACCINE LYMPH

AT THE

MASSACHUSETTS AGRICULTURAL COLLEGE,
FOR FREE DISTRIBUTION WITHIN
THE COMMONWEALTH.

Commonwealth of Massachusetts.

MASSACHUSETTS STATE BOARD OF AGRICULTURE,
ROOM 136, STATE HOUSE, BOSTON, Jan. 13, 1903.

To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.

I have the honor to transmit the accompanying report of the State Board of Agriculture as to the feasibility and probable cost of producing vaccine lymph at the Massachusetts Agricultural College, for free distribution within the Commonwealth, as required under chapter 121 of the Resolves of 1902.

This report was presented and read at the annual meeting of the State Board of Agriculture, held this day, and was by vote accepted and adopted to be transmitted to the General Court, with the recommendation that an appropriation be made for the purpose.

Respectfully,

JAMES W. STOCKWELL,
Secretary.

Report of the State Board of Agriculture as to the Feasibility and Probable Cost of producing Vaccine Lymph at the Massachusetts Agricultural College, for Free Distribution within the Commonwealth.*

In compliance with the vote of the State Board of Agriculture at its July meeting, investigations were undertaken by the committee on Massachusetts Agricultural College of the said Board.

This matter was referred to the State Board of Agriculture for investigation by chapter 121 of the Resolves of 1902, which reads: —

> *Resolved*, That the state board of agriculture is hereby authorized and directed to investigate as to the feasibility and probable cost of producing vaccine lymph at the Massachusetts agricultural college, for free distribution within the Commonwealth, and to report the result of such investigation, together with such recommendations as the board may consider advisable, to the general court on or before the fifteenth day of January in the year nineteen hundred and three.

Previous to the introduction of this resolve the matter had been referred to the State Board of Health by chapter 107 of the Resolves of 1902. A report of the State Board of Health was submitted to the Legislature, and printed as House Document, No. 1522.

Reporting for the Board, the secretary said: "We recommend that the plan which has been successfully used by us for the production and free distribution of the anti-toxine of diphtheria since 1895 be also employed for the production

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* House Document, No. 111, 1903.

and distribution of vaccine." The estimate of the Board for a suitable building for the purpose was $20,500, and for the yearly maintenance $6,500.

It would seem that a part of the buildings and equipment of the veterinary department of the college might be used in the production of vaccine. There are stables and laboratories and apparatus available and well adapted for that purpose, the use of which would make it unnecessary to duplicate the same in a new establishment. There is in the main laboratory building, at present not in use, a well-equipped private laboratory, that might be set aside for the bacteriological manipulations of vaccine production. The laboratory is provided with microscopes, sterilizers, incubators, etc. The veterinary stable has two compartments, completely separated from each other and from other parts of the building, that would serve the purpose of detention stables for stock previous to inoculation. Each section has an independent source for heat, light, water and air. The walls are of brick, rendered impervious and waterproof by the use of paint, the floors and mangers of artificial stone. In fact, the sanitary conditions are perfect, and everything arranged for the segregation of animals and effective disinfection. Another part of the building contains a post-mortem room, in which animals furnishing lymph could be slaughtered and examined prior to the distribution of the vaccine.

In addition to the buildings and equipment of the veterinary department that could be utilized in the production of lymph, it would be necessary to provide a single building containing stable room for vaccinated animals, an operating room, a small laboratory for the preparation and packing of the vaccine, and one or two small offices. Such a building should be constructed of brick, with enameled inside walls, and floors of non-absorbent material, either asphalt or artificial stone. The construction should be such as to allow of easy cleaning and thorough disinfection. To insure perfect sanitary conditions, there should be provided an effective system of drainage, heating, lighting and ventilation.

The expenditure for equipment would be limited to the purchase of such apparatus as would be required for the immediate preparation of the lymph, including fixtures for the stable and offices. The department now has such supplementary apparatus as would be necessary, such as microscopes, sterilizers, etc.

Preliminary plans of such a building as has been described have been prepared and are herewith submitted. To meet all requirements of location, etc., some slight modifications might be necessary. It is estimated that this building has sufficient capacity to produce in from four to six weeks all of the vaccine that would be required in the State, even in the event of an extended outbreak of small-pox. An architect's estimate of the cost of the building is $9,000.

For the investigation of the most modern methods of vaccine production and for the purchase of apparatus and furnishings $2,500 would be necessary.

An annual appropriation of $3,000 would be required to cover such items of expense as salaries of employees, animals, feed, heat, light and material for the preparation and package of the lymph.

The location of the college, which is only four hours by train from the extreme ends of the State, would be of distinct advantage in the distribution of vaccine to different points. The town has exceptionally good railroad, express and telephone facilities. Fifteen mails arrive and depart each day to and from different parts of the State.

The location in the Connecticut valley, where large herds of cattle are kept and an abundance of hay grown, would be advantageous in procuring animals and feed at a minimum price.

After careful investigation, this Board considers it feasible to prepare vaccine at the Massachusetts Agricultural College, and believes it can be done there at the minimum of cost.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1902.

Financial Returns of the Incorporated

	Societies.	When incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held invested as a Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural),	1881	$1,002 32	[2] $8,173 83	$8,126 77	$8,173 83
2	Barnstable County,	1844	1,710 00	[3] 8,300 00	8,300 00	9,433 00
3	Blackstone Valley,	1884	3,000 00	[4] 4,500 00	4,500 00	4,554 05
4	Bristol County,	1823	3,240 00	[4] 32,000 00	32,200 00	32,200 00
5	Deerfield Valley,	1871	4,094 01	[5] 9,200 00	9,450 00	9,450 00
6	Eastern Hampden,	1856	3,000 00	[5] 7,000 00	7,000 00	7,731 87
7	Essex,	1818	4,517 20	[6] 24,990 33	24,990 33	24,990 33
8	Franklin County,	1850	3,768 00	[7] 9,225 55	9,200 00	9,225 55
9	Hampshire,	1850	3,255 26	[4] 4,352 43	4,352 43	4,354 06
10	Hampshire, Franklin and Hampden,	1818	8,141 29	[8] 1,674 53	1,674 53	1,674 53
11	Highland,	1859	3,262 00	[4] 3,200 00	3,200 00	3,215 81
12	Hillside,	1883	3,113 32	[9] 5,450 00	5,450 00	5,506 28
13	Hingham (Agricultural and Horticultural),	1867	17,406 15	[4] 22,000 00	22,000 00	22,611 77
14	Hoosac Valley,	1860	2,006 00	[4] 16,800 00	16,800 00	16,972 84
15	Housatonic,	1848	6,335 33	[10] 24,465 76	24,890 76	24,951 15
16	Marshfield (Agricultural and Horticultural),	1867	3,755 43	[4] 14,050 00	14,050 00	14,050 00
17	Martha's Vineyard,	1859	4,552 17	[11] 4,284 17	4,284 17	4,284 17
18	Massachusetts Horticultural,	1829	525 00	[12] 564,524 70	848,255 22	848,255 22
19	Massachusetts Society for Promoting Agriculture,[1]	1792	-	-	-	-
20	Middlesex North,	1855	3,000 00	[4] 50,300 00	50,300 00	50,454 99
21	Middlesex South,	1854	3,000 00	[4] 12,000 00	12,200 00	12,243 99
22	Nantucket,	1856	3,500 00	[5] 3,200 00	3,200 00	3,228 19
23	Oxford,	1888	4,400 00	[9] 9,145 42	9,145 42	9,145 42
24	Plymouth County,	1819	9,550 00	[8] 1,491 33	1,491 33	1,491 33
25	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[4] 10,350 00	10,350 00	10,453 68
26	Union (Agricultural and Horticultural),	1867	4,447 23	[4] 9,000 00	9,000 00	9,067 00
27	Weymouth (Agricultural and Industrial),	1891	10,270 00	[4] 11,270 00	11,270 00	11,353 30
28	Worcester,	1818	7,730 00	[9] 91,464 50	91,464 50	92,077 13
29	Worcester East,	1890	2,296 23	[2] 8,019 89	8,019 89	8,019 89
30	Worcester Northwest (Agricultural and Mechanical),	1867	3,400 00	[4] 13,600 00	13,600 00	13,751 34
31	Worcester South,	1855	3,127 40	[4] 10,700 00	10,700 00	10,783 85
32	Worcester County West,	1851	3,175 00	[4] 13,600 00	13,600 00	13,758 97
			$138,673 34	$1,008,332 44	$1,293,065 35	$1,297,463 54

1 Represented on the Board by special enactment, and makes no returns.
2 Invested in real estate, cash, crockery, tables, etc.
3 Invested in real estate and bonds.
4 Invested in real estate, crockery, tables, etc.
5 Invested in real estate.
6 Invested in real estate, bonds, bank funds, crockery, tables, etc.
7 Invested in real estate, stocks, bank funds, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1902.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,721 49	-	-	-	-	$405 28	$47 06	$2,000 00	1
7,500 00	-	$800 00	-	-	-	1,133 00	1,250 00	2
4,400 00	-	-	-	$24 00	100 00	30 05	1,922 90	3
32,000 00	-	-	-	-	200 00	-	18,857 65	4
9,200 00	-	-	-	-	250 00	-	356 92	5
7,000 00	-	-	-	681 50	-	50 37	5,685 27	6
15,300 00	-	9,080 00	-	-	200 00	410 33	10,602 00	7
8,000 00	-	1,000 00	$25 55	-	200 00	-	7,100 00	8
4,200 00	-	-	-	-	152 43	1 63	1,313 00	9
-	-	-	514 63	-	1,100 00	59 90	125 00	10
3,000 00	-	-	-	-	200 00	15 81	-	11
4,500 00	-	-	600 00	-	350 00	56 28	-	12
20,000 00	-	-	-	600 00	2,000 00	11 77	-	13
16,300 00	-	-	-	-	500 00	172 84	10,000 00	14
22,000 00	-	1,000 00	1,465 76	25 00	425 00	35 39	7,787 50	15
13,300 00	-	-	-	-	750 00	-	2,904 55	16
2,750 00	$225 00	-	1,059 17	-	250 00	-	115 19	17
516,172 36	3,488 76	261,053 50	-	-	[13] 49,892 05	17,648 55	8,250 00	18
-	-	-	-	-	-	-	-	19
50,000 00	-	-	-	-	300 00	154 99	17,804 45	20
12,000 00	-	-	-	-	200 00	43 99	8,000 00	21
3,200 00	-	-	-	-	-	28 19	572 94	22
7,600 00	-	-	-	-	200 00	1,345 42	-	23
-	-	-	1,436 47	-	37 00	17 86	37 79	24
9,400 00	-	-	-	-	950 00	103 68	2,250 00	25
8,000 00	-	-	-	-	1,000 00	67 00	1,494 70	26
11,000 00	-	-	-	-	270 00	83 30	2,200 00	27
50,000 00	-	-	40,000 00	276 00	1,464 50	336 63	1,231 90	28
6,672 00	-	-	-	-	637 00	710 89	-	29
13,000 00	-	-	-	-	600 00	151 34	4,700 00	30
10,400 00	-	-	-	-	300 00	83 85	1,980 13	31
12,600 00	-	-	-	-	1,000 00	158 97	750 00	32
$887,215 85	$3,713 76	$272,933 50	$45,101 58	$1,606 50	$63,933 26	$22,959 09	$119,291 89	

[8] Invested in bank funds, cash, crockery, tables, etc.

[9] Invested in real estate, bank funds, crockery, tables, etc.

[10] Invested in real estate, stocks and bank funds.

[11] Invested in real estate, notes, bank funds, crockery, tables, etc.

[12] Invested in real estate, library, furniture, bonds and other securities.

[13] Including library.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural),	-	-	$2,000 00	$2,713 94	$571 70	-
2	Barnstable County,	-	-	1,250 00	6,477 63	600 00	-
3	Blackstone Valley,	-	$122 90	1,800 00	2,064 89	600 00	-
4	Bristol County,	$157 65	200 00	18,500 00	25,737 40	600 00	-
5	Deerfield Valley,	-	356 92	-	2,320 80	600 00	-
6	Eastern Hampden,	125 24	446 88	5,113 15	4,006 07	600 00	-
7	Essex,	-	-	10,602 00	1,543 02	600 00	-
8	Franklin County,	-	100 00	7,000 00	8,848 55	600 00	-
9	Hampshire,	-	-	1,313 00	2,156 46	600 00	-
10	Hampshire, Franklin and Hampden,	-	125 00	-	2,902 06	333 98	$14 63
11	Highland,	-	-	-	1,611 06	600 00	-
12	Hillside,	-	-	-	1,668 35	600 00	20 00
13	Hingham (Agricultural and Horticultural),	-	-	-	1,665 55	600 00	65 00
14	Hoosac Valley,	-	-	10,000 00	5,764 69	600 00	-
15	Housatonic,	-	2 25 00	7,762 50	9,382 65	600 00	48 20
16	Marshfield (Agricultural and Horticultural),	15 55	-	2,889 00	4,047 31	600 00	-
17	Martha's Vineyard,	6 00	109 19	-	1,123 86	600 00	57 29
18	Massachusetts Horticultural,	8,250 00	-	-	22,145 87	600 00	444 70
19	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-
20	Middlesex North,	104 45	-	17,700 00	3,303 60	600 00	-
21	Middlesex South,	-	-	8,000 00	1,861 74	600 00	-
22	Nantucket,	-	-	572 94	627 75	600 00	-
23	Oxford,	-	-	-	3,459 30	600 00	-
24	Plymouth County,	-	37 79	-	310 49	285 00	24 50
25	Spencer (Farmers' and Mechanics' Association),	-	250 00	2,000 00	4,288 98	600 00	-
26	Union (Agricultural and Horticultural),	9 30	85 40	1,400 00	1,966 92	600 00	-
27	Weymouth (Agricultural and Industrial),	-	-	2,200 00	4,165 27	600 00	-
28	Worcester,	-	1,231 90	-	27,164 21	600 00	1,935 19
29	Worcester East,	-	-	-	12,215 07	600 00	3 32
30	Worcester Northwest (Agricultural and Mechanical),	-	-	4,700 00	9,527 03	600 00	-
31	Worcester South,	68 60	11 53	1,900 00	4,334 81	600 00	-
32	Worcester County West,	-	-	750 00	2,373 18	600 00	8 75
		$8,736 79	$3,102 51	$107,452 59	$181,778 51	$17,990 68	$2,621 58

[1] Represented on the Board by special enactment, and makes no returns.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1902 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
-	$14 50	-	$2,127 74	$2,666 88	$791 00	$88 00	$88 75	$1,699 13	1
$20 00	-	$770 00	5,087 63	5,244 62	1,734 85	2,705 28	104 50	700 00	2
-	24 00	169 60	1,271 29	2,034 84	529 60	1,301 32	130 00	73 92	3
-	-	-	25,137 40	25,906 45	8,483 76	14,128 06	746 16	2,548 47	4
-	47 00	23 95	1,649 85	2,300 67	1,142 35	851 02	7 30	300 00	5
-	26 00	161 52	3,218 55	3,955 70	690 35	1,710 01	168 30	1,387 04	6
573 03	36 00	-	333 99	3,404 19	[3] 1,523 15	733 03	547 88	600 13	7
40 00	-	-	8,208 55	8,823 30	1,139 40	3,678 67	198 24	3,806 99	8
-	44 50	132 54	1,379 42	2,156 46	634 35	1,442 73	79 38	-	9
-	78 00	-	2,475 45	2,996 53	951 30	1,853 99	-	191 24	10
-	18 00	-	993 06	1,595 05	661 55	804 06	4 20	125 24	11
-	95 00	-	953 35	2,008 10	925 35	573 75	-	509 00	12
-	5 00	52 55	943 00	1,665 39	684 35	622 27	14 30	344 47	13
-	20 00	-	5,144 69	5,487 85	706 10	3,319 35	500 00	962 40	14
50 00	162 00	-	8,522 45	7,347 26	2,081 50	3,691 80	320 00	1,253 96	15
-	30 00	295 00	3,122 31	3,447 31	1,183 28	1,121 46	208 37	934 20	16
-	14 00	1 21	451 36	1,107 36	738 89	234 67	-	133 80	17
10,446 67	1,498 00	850 00	8,306 50	30,979 04	[3] 4,202 92	19,566 38	448 93	6,760 81	18
-	-	-	-	-	-	-	-	-	19
-	-	-	2,703 60	4,455 71	664 75	928 19	733 50	2,129 27	20
-	17 75	85 00	1,158 99	1,834 28	778 95	972 58	82 75	-	21
-	22 00	5 75	-	1,288 98	610 50	678 48	-	-	22
-	16 00	1 75	2,841 55	2,113 88	1,327 06	356 09	-	430 73	23
-	-	-	99	292 63	275 00	17 63	-	-	24
-	28 00	-	3,660 98	3,278 83	1,944 31	1,324 52	10 00	-	25
-	36 00	-	1,330 92	1,899 92	1,030 20	471 88	104 13	293 71	26
-	-	-	3,565 27	4,162 64	752 25	150 00	56 25	3,204 14	27
-	70 00	-	24,559 02	26,997 58	3,210 00	2,237 02	219 73	21,330 83	28
-	55 00	245 00	11,311 75	11,498 28	1,608 50	9,561 23	-	328 55	29
-	10 00	748 00	8,169 03	9,375 69	1,121 25	6,600 29	204 15	1,450 00	30
-	111 00	6 50	3,617 31	4,436 87	1,816 00	1,732 87	100 00	788 00	31
-	45 00	41 22	1,678 21	3,919 37	1,829 98	2,089 39	-	-	32
$11,129 70	$2,522 75	$3,589 59	$143,924 21	$188,684 67	$45,772 80	$85,546 02	$5,076 82	$52,286 03	

[2] Estimated. [3] Awarded in 1901.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$1,519 50	$848 80	$791 00	$80 00	-	-	$800 00
2	Barnstable County,	2,545 00	1,734 85	1,734 85	123 00	-	-	625 50
3	Blackstone Valley,	865 00	529 60	529 60	45 00	$39 00	$39 00	625 00
4	Bristol County,	8,818 00	8,641 41	8,483 76	25 00	25 00	25 00	1,373 00
5	Deerfield Valley,	1,426 95	1,166 30	1,142 35	-	-	-	835 00
6	Eastern Hampden,	1,791 00	690 35	690 35	122 00	27 00	27 00	695 75
7	Essex,	2,603 50	1,650 50	[2] 1,523 15	119 00	20 00	-	1,284 00
8	Franklin County,	[3] 1,400 00	1,139 40	1,139 40	-	-	-	[3] 1,000 00
9	Hampshire,	1,210 00	634 35	634 35	50 00	6 00	6 00	827 00
10	Hampshire, Franklin and Hampden,	1,448 50	1,046 05	951 30	50 00	-	-	942 00
11	Highland,	731 55	661 55	661 55	-	-	-	421 00
12	Hillside,	800 00	925 35	925 35	8 00	8 00	8 00	517 75
13	Hingham (Agricultural and Horticultural),	1,499 00	684 35	684 35	207 75	-	-	-
14	Hoosac Valley,	1,698 75	706 10	706 10	-	-	-	1,323 00
15	Housatonic,	2,848 50	2,081 50	2,081 50	-	-	-	1,672 50
16	Marshfield (Agricultural and Horticultural),	1,892 00	1,209 18	1,183 28	110 00	10 00	10 00	458 50
17	Martha's Vineyard,	790 75	750 44	738 89	39 00	29 50	29 50	460 00
18	Massachusetts Horticultural,	8,200 00	4,215 92	[2] 4,202 92	677 00	536 50	[2] 595 00	-
19	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-	-
20	Middlesex North,	1,202 00	769 20	664 75	-	-	-	529 00
21	Middlesex South,	1,484 00	903 40	778 95	45 00	-	-	827 00
22	Nantucket,	1,241 00	610 50	610 50	96 00	12 00	12 00	690 00
23	Oxford,	1,800 00	1,353 00	1,327 06	78 00	35 50	35 50	874 00
24	Plymouth County,	275 00	275 00	275 00	-	-	-	125 00
25	Spencer (Farmers' and Mechanics' Association),	2,200 00	1,989 00	1,944 31	51 00	26 00	26 00	1,119 50
26	Union (Agricultural and Horticultural),	1,528 75	1,052 30	1,030 20	10 00	5 00	5 00	875 50
27	Weymouth (Agricultural and Industrial),	1,105 65	804 20	752 25	-	-	-	679 00
28	Worcester,	5,224 50	3,210 00	3,210 00	31 00	31 00	31 00	3,035 00
29	Worcester East,	2,400 00	1,608 50	1,608 50	27 00	-	-	1,680 00
30	Worcester Northwest (Agricultural and Mechanical),	1,432 00	1,170 00	1,121 25	22 00	21 00	17 00	1,028 00
31	Worcester South,	2,430 00	1,884 60	1,816 00	113 00	63 00	63 00	812 50
32	Worcester County West,	2,110 70	1,871 20	1,829 98	66 00	32 00	32 00	833 50
		$66,521 60	$46,816 90	$45,772 80	$2,194 75	$926 50	$961 00	$26,968 00

1 Held no fair and made no return.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1902.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$476 50	$461 50	$180 00	–	–	$250 00	$189 65	$169 15	$3 25	$3 25	1
336 00	336 00	149 00	$38 50	$38 50	289 00	209 05	209 05	10 00	8 00	2
407 00	391 70	–	–	–	115 00	83 35	80 00	5 00	–	3
1,143 25	1,058 55	–	–	–	407 00	423 20	404 65	50 00	25 00	4
612 00	597 95	–	–	–	123 50	107 50	105 15	18 00	9 00	5
451 75	451 75	98 50	26 00	26 00	153 25	127 50	127 50	18 00	3 00	6
783 00	[2] 936 00	272 00	69 00	[2] 29 00	500 00	446 00	[2] 430 00	16 00	5 00	7
851 90	851 90	–	–	–	225 00	181 75	181 75	22 00	10 00	8
377 00	377 00	–	–	–	170 00	128 00	128 00	13 00	6 00	9
724 30	690 30	102 00	36 00	33 00	183 50	154 25	127 00	36 00	17 00	10
368 25	368 25	35 00	30 00	30 00	61 00	60 80	60 80	7 50	7 00	11
517 75	517 75	60 00	57 00	57 00	80 00	81 00	81 00	11 00	6 50	12
–	–	37 00	16 00	16 00	1,020 00	533 10	533 10	3 50	1 00	13
412 50	412 50	–	–	–	114 00	70 25	70 25	18 00	13 00	14
1,084 50	1,081 50	268 00	241 00	241 00	353 00	333 50	333 50	42 00	41 00	15
228 10	219 10	–	–	–	312 00	189 10	168 60	12 50	3 00	16
323 00	323 00	151 15	83 00	83 00	110 00	105 95	105 95	13 00	12 60	17
–	–	–	–	–	8,686 00	6,648 41	[2] 3,607 92	–	–	18
–	–	–	–	–	–	–	–	–	–	19
329 00	[2] 299 00	98 25	72 20	[2] 70 00	417 80	245 75	[3] 220 75	4 50	–	20
248 00	128 00	42 00	–	–	180 20	119 70	112 25	6 00	3 00	21
277 00	277 00	174 00	60 00	60 00	137 00	26 00	26 00	16 00	–	22
537 00	524 50	38 25	29 00	26 93	78 50	33 00	30 83	12 00	8 00	23
125 00	125 00	–	–	–	70 00	70 00	70 00	–	–	24
885 85	845 85	–	–	–	178 25	141 00	141 00	200 00	145 00	25
553 25	544 25	95 50	50 50	50 50	53 25	43 75	41 25	13 25	8 75	26
390 75	358 05	46 00	13 00	13 00	210 00	203 10	187 50	5 50	–	27
1,960 50	1,960 50	–	–	–	351 50	293 50	293 50	126 00	113 00	28
1,084 25	1,084 25	–	–	–	353 00	283 50	283 50	21 00	4 00	29
925 50	890 00	–	–	–	272 50	153 50	153 50	30 00	5 00	30
650 00	649 00	–	–	–	186 50	157 15	148 40	23 00	12 00	31
663 75	638 75	–	–	–	112 45	108 15	92 73	15 00	5 00	32
$17,726 65	$17,401 90	$1,846 65	$821 20	$773 93	$15,753 20	$11,950 46	$8,724 58	$771 00	$474 10	

[2] Awarded in 1901, paid in 1902. [3] Estimated.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$3 25	$125 00	$98 15	$83 15	$81 25	$73 95
2	Barnstable County,	8 00	208 00	202 80	202 80	240 50	240 50
3	Blackstone Valley,	-	75 00	19 70	19 70	-	-
4	Bristol County,	25 00	390 00	274 00	242 00	176 00	160 05
5	Deerfield Valley,	7 00	93 20	89 25	85 65	68 55	66 60
6	Eastern Hampden,	3 00	76 50	55 10	55 10	-	-
7	Essex,	-	204 00	119 00	[2] 121 50	208 50	186 00
8	Franklin County,	10 00	160 00	137 25	137 25	-	-
9	Hampshire,	6 00	75 00	55 00	55 00	53 00	53 00
10	Hampshire, Franklin and Hampden,	11 00	135 00	61 50	46 00	53 00	44 00
11	Highland,	7 00	79 05	74 30	74 30	46 20	46 20
12	Hillside,	6 50	93 00	105 15	105 15	62 25	59 25
13	Hingham (Agricultural and Horticultural),	1 00	103 75	82 25	82 25	52 00	52 00
14	Hoosac Valley,	13 00	204 25	170 85	170 85	39 50	39 50
15	Housatonic,	41 00	513 00	381 50	381 50	-	-
16	Marshfield (Agricultural and Horticultural),	3 00	230 00	81 18	81 18	77 80	77 55
17	Martha's Vineyard,	12 60	140 00	135 64	135 64	79 00	79 00
18	Massachusetts Horticultural,	-	-	-	-	-	-
19	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-
20	Middlesex North,	-	131 50	57 65	[3] 55 00	20 00	[3] 20 00
21	Middlesex South,	3 00	83 25	46 20	46 20	17 00	17 00
22	Nantucket,	-	128 00	74 75	74 75	50 75	50 75
23	Oxford,	7 50	76 50	55 50	46 80	-	-
24	Plymouth County,	-	60 00	60 00	60 00	20 00	20 00
25	Spencer (Farmers' and Mechanics' Association),	145 00	67 50	49 75	49 75	41 00	41 00
26	Union (Agricultural and Horticultural),	8 75	134 40	113 10	106 23	37 95	34 22
27	Weymouth (Agricultural and Industrial),	-	165 15	147 90	144 40	49 45	49 30
28	Worcester,	113 00	12 00	12 00	12 00	-	-
29	Worcester East,	4 00	136 00	98 75	98 75	111 00	111 00
30	Worcester Northwest (Agricultural and Mechanical),	5 00	62 00	47 50	38 75	17 50	17 00
31	Worcester South,	12 00	78 75	61 20	55 50	16 25	10 25
32	Worcester County West,	5 00	68 75	47 80	47 00	14 50	14 50
		$460 60	$4,098 55	$3,014 72	$3,014 35	$1,632 95	$1,562 62

[1] Held no fair and made no return.
[2] Awarded in 1901, paid in 1902.
[3] Estimated.
[4] Including other attractions.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1902 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institutes held.	Average Number attending Institutes.	
–	361	98	14	$156 00	208	41	249	3	67	1
$900 00	210	220	11	–	258	240	498	3	103	2
–	83	12	13	–	293	281	574	4	69	3
[4] 6,573 00	630	6	[3] 25	205 30	607	109	716	3	208	4
277 00	275	–	20	75	891	250	1,141	4	99	5
700 00	123	–	24	23 50	256	190	446	3	54	6
–	411	–	25	–	1,160	12	1,172	3	79	7
1,200 00	250	–	23	–	[3] 1,200	[3] 400	[3] 1,600	3	32	8
460 00	124	5	18	–	532	203	735	3	107	9
357 50	189	22	23	–	712	268	980	3	127	10
75 00	128	6	22	8 20	258	123	381	3	83	11
60 00	325	1	25	–	790	40	830	3	145	12
–	85	65	11	–	436	179	615	5	117	13
1,325 00	151	–	13	76 00	954	15	969	3	25	14
787 50	374	–	18	–	1,556	54	1,610	3	72	15
630 00	57	228	25	33 50	544	299	843	3	56	16
–	65	212	4	–	96	84	180	3	27	17
–	152	61	69	207 50	780	103	883	9	70	18
–	–	–	–	–	–	–	–	–	–	19
–	327	53	11	–	1,114	449	1,563	4	169	20
472 50	90	43	8	–	363	216	579	3	150	21
110 00	109	64	1	–	247	389	636	3	50	22
655 00	93	–	19	60 00	341	279	620	3	127	23
–	[5] –	[5] –	[5] –	–	750	575	1,325	4	58	24
602 50	178	–	20	–	463	411	874	3	80	25
240 00	157	83	25	3 88	635	804	1,439	3	188	26
–	350	250	20	49 00	480	10	490	3	42	27
800 00	232	–	54	322 00	1,660	166	1,826	3	[6] –	28
1,055 00	194	52	40	200 50	449	271	720	3	105	29
1,450 00	[6] –	[6] –	32	178 75	678	386	1,064	4	160	30
925 00	125	42	19	–	775	756	1,531	3	53	31
1,000 00	167	27	23	65 25	420	67	487	3	108	32
$20,655 00	6,015	1,550	655	$1,590 13	19,906	7,670	27,576	106	[7] 104	

[5] Premiums paid through Marshfield Agricultural and Horticultural Society.

[6] Made no return.

[7] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN MASSACHUSETTS.

MAY, 1903.

State Board of Agriculture, 1903.

Members ex Officio.

His Excellency JOHN L. BATES.
His Honor CURTIS GUILD, Jr.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, V.S., *Chief of the Cattle Bureau.*
JAMES W. STOCKWELL, *Secretary to July 1.*
J. LEWIS ELLSWORTH, *Secretary from July 1.*

Members appointed by the Governor and Council.

	Term Expires
WARREN C. JEWETT of Worcester,	1904
WILLIAM R. SESSIONS of Springfield,	1905
FRANCIS H. APPLETON of Peabody,	1906

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1906
Barnstable County,	JOHN BURSLEY of West Barnstable,	1904
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1906
Bristol County,	WILLIAM A. LANE of Norton (P. O. Barrowsville),	1905
Deerfield Valley,	ARTHUR A. SMITH of Colrain (P. O. Lyonsville),	1905
Eastern Hampden,	O. E. BRADWAY of Monson,	1906
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1905
Franklin County,	JOHN S. ANDERSON of Shelburne,	1904
Hampshire,	A. M. LYMAN of Montague,	1904
Hampshire, Franklin and Hampden,	J. F. BURT of Easthampton,	1906
Highland,	C. K. BREWSTER of Worthington,	1905
Hillside,	J. W. GURNEY of Cummington,	1905
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1906
Hoosac Valley,	A. M. STEVENS of Williamstown,	1906
Housatonic,	CHARLES H. SHAYLOR of Lee,	1906
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1906
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1904
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1906
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1906
Middlesex North,	H. S. PERHAM of Chelmsford,	1904
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1905
Nantucket,	H. G. WORTH of Nantucket,	1906
Oxford,	W. M. WELLINGTON of Oxford,	1904
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1905
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1904
Union (Agr'l and Hort'l),	ENOS W. BOISE of Blandford,	1904
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1906
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1905
Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1904
Worcester South,	C. D. RICHARDSON of West Brookfield,	1904
Worcester County West,	J. HARDING ALLEN of Barre,	1905

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . . . HIS EXCELLENCY JOHN L. BATES, *ex Officio*.
1st Vice-President, WILLIAM R. SESSIONS of Springfield.
2d Vice-President, . AUGUSTUS PRATT of North Middleborough.
Secretary, . . JAMES W. STOCKWELL of Sutton (to July 1). J. LEWIS ELLSWORTH of Worcester (from July 1).
Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. KILBOURN of South Lancaster.
ISAAC DAMON of Wayland.
JOHN BURSLEY of West Barnstable.
WM. H. SPOONER of Boston.
FRANCIS H. APPLETON of Peabody.
AUGUSTUS PRATT of North Middleborough.
J. L. ELLSWORTH of Worcester.
EDMUND HERSEY of Hingham.

Committee on Agricultural Societies.

Messrs. W. A. KILBOURN of South Lancaster.
Q. L. REED of South Weymouth.
O. E. BRADWAY of Monson.
J. HARDING ALLEN of Barre.
J. F. BURT of Easthampton.

Committee on Domestic Animals and Sanitation.

Messrs. ISAAC DAMON of Wayland.
JOHNSON WHITING of West Tisbury.
JOHN S. ANDERSON of Shelburne.
WM. A. LANE of Norton.
A. M. STEVENS of Williamstown.

Committee on Gypsy Moth, Insects and Birds.

Messrs. AUGUSTUS PRATT of North Middleborough.
J. M. DANFORTH of Lynnfield.
JOHN G. AVERY of Spencer.
WM. R. SESSIONS of Springfield.
W. C. JEWETT of Worcester.

Committee on Dairy Bureau and Agricultural Products.

Messrs. J. L. ELLSWORTH of Worcester.
C. D. RICHARDSON of West Brookfield.
J. M. DANFORTH of Lynnfield.
W. M. WELLINGTON of Oxford.
A. M. LYMAN of Montague.
N. I. BOWDITCH of Framingham.

Committee on Massachusetts Agricultural College.

Messrs. JOHN BURSLEY of West Barnstable.
C. K. BREWSTER of Worthington.
W. C. JEWETT of Worcester.
ARTHUR A. SMITH of Colrain.
CHARLES H. SHAYLOR of Lee.

Committee on Experiments and Station Work.

Messrs. WM. H. SPOONER of Boston.
T. H. GOODSPEED of Athol.
N. I. BOWDITCH of Framingham.
S. B. TAFT of Uxbridge.
EDMUND HERSEY of Hingham.

Committee on Forestry, Roads and Roadside Improvements.

Messrs. FRANCIS H. APPLETON of Peabody.
H. A. TURNER of Norwell.
J. W. GURNEY of Cummington.
H. G. WORTH of Nantucket.
J. J. MASON of Amesbury.

Committee on Institutes and Public Meetings.

Messrs. EDMUND HERSEY of Hingham.
H. H. GOODELL of Amherst.
E. W. BOISE of Blandford.
JOHN G. AVERY of Spencer.
H. S. PERHAM of Chelmsford.

The secretary is a member, *ex officio*, of each of the above committees.

DAIRY BUREAU.

Messrs. J. Lewis Ellsworth of Worcester, 1903; J. M. Danforth of Lynnfield, 1904; C. D. Richardson of West Brookfield, 1905.

Executive Officer, ...	J. W. Stockwell (to July 1). J. L. Ellsworth (from July 1).
General Agent, ...	P. M. Harwood of Barre.

CATTLE BUREAU.

Austin Peters, V.S., *Chief.*

STATE NURSERY INSPECTOR.

Henry T. Fernald, Ph.D., of Amherst.

SPECIALISTS.

By Election of the Board.

Chemist, ...	Dr. C. A. Goessmann, ...	Amherst.
Entomologist, ...	Prof. C. H. Fernald, ...	Amherst.
Botanist and Pomologist, .	Prof. F. A. Waugh, ...	Amherst.
Veterinarian, ...	Prof. James B. Paige, ...	Amherst.
Engineer, ...	Wm. Wheeler, ...	Concord.
Ornithologist, ...	E. H. Forbush, ...	Wareham.

By Appointment of the Secretary.

Librarian, F. H. Fowler, B.Sc., *First Clerk.*

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

HENRY H. GOODELL, M.A., LL.D.,	*Director.*
WILLIAM P. BROOKS, B.Sc.,	*Agriculturist.*
F. A. WAUGH, B.Sc.,	*Horticulturist.*
CHARLES H. FERNALD, Ph.D.,	*Entomologist.*
HENRY T. FERNALD, Ph.D.,	*Assistant Entomologist.*
CHAS. A. GOESSMANN, Ph.D., LL.D.,	*Chemist* (Fertilizers).
JOSEPH B. LINDSEY, Ph.D.,	*Chemist* (Foods and Feeding).
GEORGE E. STONE, Ph.D.,	*Botanist.*
J. E. OSTRANDER, C.E.,	*Meteorologist.*

AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF THE LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Amesbury and Salisbury,*	J. J. Mason, Amesbury.	J. E. Brierly, Amesbury.	J. E. Brierly, Amesbury.
Barnstable County,	D. Gorham Bacon, Yarmouth.	T. C. Day, Barnstable.	A. F. Sherman, Barnstable.
Blackstone Valley,	Samuel B. Taft, Uxbridge.	Edwin F. Tuttle, Uxbridge.	L. A. Seagrave, Uxbridge.
Bristol County,	Herbert A. Dean, Berkley.	Carleton F. Sanford, Taunton.	E. C. Holt, Taunton.
Deerfield Valley,	E. P. Williams, Shelburne.	S. W. Hawkes, Charlemont.	E. F. Haskins, Charlemont.
Eastern Hampden,	O. E. Bradway, Monson.	L. E. Chandler, Palmer.	D. L. Bodfish, Palmer.
Essex,	F. H. Appleton, Peabody.	J. M. Danforth, Lynnfield.	W. S. Nichols, Salem.
Franklin County,	Frank O. Wells, Greenfield.	Henry J. Field, Greenfield.	Henry J. Field, Greenfield.
Hampshire,	Henry E. Paige, Amherst.	George A. Drew, Amherst.	George A. Drew, Amherst.
Hampshire, Franklin and Hampden,	J. F. Burt, Easthampton.	C. A. Montgomery, Northampton.	D. J. Wright, Northampton.
Highland,	Henry S. Pease, Middlefield.	J. T. Bryan, Middlefield.	M. J. Smith, Middlefield.
Hillside,	W. H. Harlow, Cummington.	C. M. Cudworth, Cummington.	D. E. Lyman, Cummington.
Hingham,*	U. S. Bates, Hingham.	William H. Thomas, Hingham.	Reuben Sprague, Hingham.
Hoosac Valley,	C. E. Winchell, North Adams.	A. P. Carpenter, North Adams.	M. R. Ford, North Adams.
Housatonic,	N. B. Turner, Great Barrington.	F. H. Briggs, Great Barrington.	O. C. Bidwell, Great Barrington.
Marshfield,*	H. A. Oakman, North Marshfield.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard,	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	O. B. Hadwen, Worcester.	Wm. P. Rich, Boston.	C. E. Richardson, Brookline.
Massachusetts Society for Promoting Agriculture,	C. S. Sargent, Brookline.	F. H. Appleton, Peabody.	R. M. Saltonstall, Newton.
Middlesex North,	A. J. Trull, Tewksbury.	Frank J. Sherwood, Lowell.	Fred H. Ela, Lowell.
Middlesex South,	S. O. Staples, South Framingham.	G. E. Harrington, South Framingham.	S. B. Bird, Framingham.
Nantucket,	H. G. Worth, Nantucket.	J. F. Murphey, Nantucket.	Asa C. Jones, Nantucket.
Oxford,	Chas. B. Sherman, Oxford.	J. E. Darling, Oxford.	J. E. Darling, Oxford.
Plymouth County,	Augustus Pratt, North Middleborough.	G. M. Hooper, Bridgewater.	Geo. M. Hooper, Bridgewater.

* And horticultural.

Agricultural Societies, etc. — *Concluded.*

NAME.	PRESIDENT.	SECRETARY.	TREASURER.
Spencer (Farmers' and Mechanics' Association),	Edward Warren, Leicester.	H. H. Capen, Spencer.	H. H. Capen, Spencer.
Union,*	H. K. Herrick, Blandford.	E. W. Boise, Blandford.	Geo. O. Willard, Blandford.
Weymouth (Ag'l and Ind.),	Gordon Willis, South Weymouth.	T. L. Tirrell, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester,	B. W. Potter, Worcester.	J. E. Gifford, Sutton.	R. J. Healey, Worcester.
Worcester East,	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	Lucius Field, Clinton.
Worcester Northwest (Agricultural and Mechanical),	Dr. James Oliver, Athol.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South,	C. D. Paige, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	Geo. H. Ellis, West Newton.	Matthew Walker, Barre.	C. H. Follansby, Barre.

* And horticultural.

HORTICULTURAL SOCIETIES.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Cape Ann,	Gloucester,	Bennett Griffin, Gloucester.	William D. Lufkin, Gloucester.
Haverhill,	Haverhill,	Walter Goodrich, Haverhill.	Mrs. William M. Webster, Haverhill.
Hampden County,	Springfield,	Jacob C. Lutz, Springfield.	William F. Gale, City Hall, Springfield.
Houghton,	Lynn,	Walter B. Allen, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox,	Lenox,	Alfred H. Wingett, Lenox.	F. Heeremans, Lenox.
Massachusetts,	The State,	O. B. Hadwen, Worcester.	Wm. R. Rich, Boston.
Springfield Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County,	Worcester County,	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	Henry F. Haynes, Bolton.	Wm. M. Brigham, Bolton.
Leominster,	Leominster,	George M. Kendall, Leominster.	C. C. Foster, Leominster.
Middlesex and Worcester,	Hudson,	Oliver Sawyer, Hudson.	Josiah S. Welsh, Hudson.
Needham,	Needham,	Merritt S. Keith, Wellesley Hills.	Chas. C. J. Spear, Charles River Village.
Oakham,	Oakham,	H. A. Crawford, Oakham.	H. W. Lincoln, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	Judson Foster, South Leominster.	H. J. Partridge, Westminster.

Farmers' and Mechanics' Clubs.

Ashburnham,	Ashburnham,	E. J. Forristal, South Ashburnham.	Walter E. Jefts, Ashburnham.
Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	L. H. Howe, Holden.	Albert F. Newell, Holden.
Pepperell,	Pepperell,	W. F. Dennen, Pepperell.	H. W. Hutchinson, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Ashfield,	Ashfield,	John M. Sears, Ashfield.	A. G. Howes, Ashfield.
Boxborough,	Boxborough,	Frank A. Patch, Littleton.	C. T. Wetherbee, West Acton.
Buckland,	Buckland,	C. O. Temple, Shelburne Falls.	W. D. Forbes, Shelburne Falls.
Chamberlain District,	Worcester,	Pliny Moore, Worcester.	Silas A. Burgess, Worcester.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	C. M. Allen, Franklin.	L. W. Daniels, Franklin.
Halifax,	Halifax,	Van Buren Grover, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	Geo. F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	Luther Crawford, New Braintree.	Mrs. Horatio Moore, New Braintree.
New Salem,	New Salem,	D. F. Carpenter, Millington.	Willard Putnam, Cooleyville.
Rehoboth,	Rehoboth,	Dr. C. H. Raymond, Rehoboth.	C. W. Goff, South Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Rutland,	Rutland,	Wm. C. Temple, Rutland.	Mrs. W. G. Wales, Rutland.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	H. Ward Moore, Worcester.	Herbert R. Kinney, Worcester.
Upton,	Upton,	Geo. H. Stoddard, Upton.	Francis T. Nelson, Upton.
West Brookfield,	West Brookfield,	Herbert N. Shepard, Warren.	S. H. Reed, West Brookfield.
West Newbury,	West Newbury,	Samuel E. Emery, Newburyport.	Parker H. Nason, West Newbury.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	Henry M. Bliss, Wilbraham.

Poultry Associations.

Adams Poultry Association,	Adams,	Dr. T. I. Wilder, Adams.	A. W. Safford, Adams.
Amesbury Poultry and Pet Stock Association,	Amesbury,	C. B. Frost, Amesbury.	M. H. Sands, Amesbury.
Athol Poultry and Pet Stock Association,	Athol,	- - -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	Frank Woodbury, Beverly.	Arthur Elliott, Peabody.
Fitchburg Poultry and Pet Stock Association,	Fitchburg,	Frank A. Wood, Fitchburg.	J. Lee Forest, Fitchburg.
Lawrence Poultry and Pet Stock Association,	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Methuen Grange Poultry Association,	Methuen,	- - -	J. S. Crosby, Methuen.
Middlesex Poultry Fanciers' Association,	South Framingham,	C. H. B. Chapin, South Framingham.	T. W. Jennings, South Framingham.
New Bedford Poultry Association,	New Bedford,	Jas. B. Hamlin, Acushnet.	Norman Barstow, New Bedford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northampton Poultry Association,	Northampton,	Dr. J. B. Paige, Amherst.	C. E. Hodgkins, Northampton.
Plymouth Poultry Association,	Plymouth,	- - -	A. R. Gledhill, Plymouth.
Springfield Poultry and Pet Stock Association,	Springfield,	Donald Birnie, Springfield.	W. R. Graves, West Springfield.

Miscellaneous.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
Bay State Agricultural Society,	The State,	C. M. Weld, Boston.	N. I. Bowditch, Framingham.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. B. Shurtleff, Jr., Revere.
Bristol Co. Fruit Growers' Association,	Dighton,	D. F. Lane, Segregansett.	Wm. P. Eddy, Dighton.
Brockton Agricultural Society,	Brockton,	Henry W. Robinson, Brockton.	Baalis Sanford, Brockton.
Cranberry Growers' Association,	Cape Cod District,	Emulous Small, Harwichport.	Franklin Crocker, Hyannis.
Franklin Harvest Club,	Connecticut Valley,	Wm. R. Sessions, Springfield.	C. B. Lyman, Southampton.
Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	C. A. Judd, South Hadley Falls.
Massachusetts Creamery Association,	The State,	Watson H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Medford.
Massachusetts Fruit Growers' Association,	The State,	A. G. Sharp, Richmond.	F. A. Smith, Hopedale.
Middlesex East Agricultural Association,	Wakefield,	Geo. A. Shackford, Reading.	B. F. Calley, Jr., East Saugus.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Westborough Agricultural Society,	Westborough,	John B. Fitch, Westborough.	George M. Howe, Westborough.
Worcester County Bee-keepers' Association,	Worcester,	Chas. E. Prouty, Auburn.	C. R. Russell, Worcester.
Worcester North Agricultural Society,	Fitchburg,	W. H. Laws, Ashburnham.	John H. White, Fitchburg.

MASSACHUSETTS PATRONS OF HUSBANDRY.

Officers of the State Grange, 1903.

Master,	George S. Ladd of Sturbridge.
Overseer,	Carlton D. Richardson of West Brookfield.
Lecturer,	Charles H. Rice of Leominster.
Steward,	John E. Gifford of Sutton.
Assistant Steward,	Herbert Sabin of Amherst.
Chaplain,	Rev. A. H. Wheelock of Millis.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton.
Gate Keeper,	I. H. Lamb of Stoughton.
Pomona,	Miss Mary E. Cutler of Holliston.
Flora,	Mrs. Ethel C. Plumb of Springfield.
Ceres,	Mrs. Mary E. Jewett of Worcester.
Lady Assistant Steward,	Mrs. S. Ella Southland of Athol.

Executive Committee.

C. A. Dennen,	Pepperell.
George L. Clemence,	Southbridge.
Elmer D. Howe,	Marlborough.

General Deputy.

C. D. Richardson,	West Brookfield.

Pomona Deputies.

Hon. M. A. Morse,	Belchertown.
Hon. F. A. Patch,	Littleton.
Dr. James Oliver,	Athol.

Subordinate Grange Deputies.

Marcellus Boynton,	Assonet.
E. E. Chapman,	Ludlow.
Geo. E. Crosby,	Tewksbury.
C. C. Colby,	Hubbardston.
F. H. Stevens,	West Acton.
C. A. Stimson,	Royalston.
E. A. Emerson,	Haverhill.
B. H. Ellis,	Westfield.
Geo. W. Sherman,	Brimfield.
L. R. Smith,	Hadley.
M. D. Herrick,	North Orange.
C. O. Littlefield,	South Framingham.
E. H. Gilbert,	Stoughton.
W. D. Seaver,	Gardner.
L. H. Cudworth,	Oxford.
W. H. Sawyer,	Winchendon.

Special Deputies.

Wm. N. Howard,	South Easton.
F. H. Plumb,	Springfield.
Herbert Sabin,	Amherst.
T. E. Flarity,	Townsend.
W. T. Herrick,	Harding.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Pomona Granges.			
Middlesex and Norfolk, No. 1,	C. O. Littlefield, South Framingham.	N. B. Douglas, Sherborn.	Mrs. Geo. L. Whitney, So. Framingham.
Essex County, No. 2,	Asa C. Gordon, Ayer's Village.	Mrs. E. M. Newell, West Newbury.	Miss Matilda B. Lund, West Boxford.
Middlesex and Worcester, No. 3,	S. R. Walker, Leominster.	Mrs. L. E. Starr, Pepperell.	G. A. Wilder, Townsend.
Franklin and Worcester, No. 4,	C. A. Stimson, Athol.	S. C. Perham, Athol.	L. E. Stewart, Athol.
Worcester West, No. 5,	Charles C. Colby, Hubbardston.	Mrs. Lizzie Patterson, Barre.	Mrs. Eva S. Moore, Hubbardston.
Berkshire County, No. 6,	C. C. Robinson, Hinsdale.	John H. Smith, Dalton.	Mrs. Nina P. Morse, Dalton.
Worcester Central, No. 7,	Geo. I. Stowe, West Millbury.	Adin A. Hixon, Worcester.	Mrs. Ellen M. Hayward, Millbury.
Hampshire County, No. 8,	George E. Clark, Sunderland.	M. A. Morse, Belchertown.	Mrs. C. Morehouse, Amherst.
Worcester Southwest, No. 9,	W. H. Hinman, Fiskdale.	Arthur Plimpton, Globe Village.	Mary Q. Ainsworth, Sturbridge.
Worcester and Norfolk, No. 10,	Wm. P. Greenwood, Milford.	Wm. J. Taylor, Blackstone.	A. W. Gaskill, Mendon.
Borough, No. 11,	Frank A. Patch, Littleton.	Mrs. Mary C. Graham, Westborough.	Mrs. S. Mabel Thompson, Woodville.
Springfield, No. 12,	E. E. Chapman, Ludlow.	Chas. B. Bennett, Ludlow.	Mrs. Carrie L. Hayward, Agawam.
Old Colony, No. 13,	Marcellus Boynton, Assonet.	Ernest H. Gilbert, Stoughton.	Mrs. Alida N. Stevens, South Braintree.
Worcester East, No. 14,	Marshall Walcott, Bolton.	Mrs. C. H. Rice, Leominster.	Mrs. E. T. Cunningham, Lancaster.
Quabaug, No. 15,	A. B. Patrick, Warren.	A. C. Stoddard, North Brookfield.	Carrie A. Smith, West Brookfield.
Middlesex North, No. 16,	Fred L. Fletcher, West Chelmsford.	Geo. E. Crosby, Tewksbury.	Mrs. M. A. Roby, Westford.
Franklin County, No. 17,	George W. Cary, Colrain.	G. Alvin Grover, Charlemont.	Mrs. Anna L. Henry, Rowe.
Subordinate Granges.			
Northfield, No. 3,	Frank H. Montague, Northfield Farms.	Mrs. W. D. Morgan, Northfield.	Miss Ethyl Heald, East Northfield.
Groton, No. 7,	Jas. P. Fitch, Groton.	Mrs. L. E. Starr, Pepperell.	Mrs. Ella P. Woolley, Groton.
Conway, No. 8,	Wm. T. Graves, Conway.	Edward Graves, Conway.	C. F. Elmer, Conway.
Barre, No. 9,	John L. Smith, Barre.	Mrs. Sara Burt, Barre.	Mrs. Minnie E. Rice, Barre.
"Hope" of Hadley, No. 15,	Wm. Parker, Hadley.	Leslie R. Smith, Hadley.	L. Stanley Davis, Hadley.
Amherst, No. 16,	Chas. H. Hooker, Amherst.	C. L. Nims, Amherst.	Mrs. T. E. Brigham, Amherst.
Cheshire, No. 17,	Henry N. Jenks, Adams.	Mrs. R. P. Purdy, Cheshire.	Jabez C. Jenks, Adams.
Hinsdale, No. 19,	Thos. F. Barker, Hinsdale.	Mrs. C. E. Robinson, Hinsdale.	C. E. Robinson, Hinsdale.

Westfield, No. 20,	Chas. M. Gardner, Westfield.	Mrs. Wm. Arnold, Westfield.	Miss Annette Sackett, Westfield.
Worcester, No. 22,	Edward H. Moore, Worcester.	Mrs. Warren C. Jewett, Worcester.	Mrs. Nancy E. Moore, Worcester.
Dalton, No. 23,	W. B. Warren, Dalton.	Mrs. S. I. Parker, Dalton.	Miss Edna M. Groesbeck, Dalton.
Blandford, No. 24,	Ely Wyman, Blandford.	Miss Mabel L. Sharp, Blandford.	W. J. Peebles, Blandford.
New Lenox, No. 26,	John H. Root, Lenox.	Mrs. E. A. Howland, New Lenox.	George M. Parker, New Lenox.
Easthampton, No. 27,	Wm. Hannum, Easthampton.	W. M. Gaylord, Easthampton.	Miss Clara Hannum, Easthampton.
Richmond, No. 32,	Robert P. Coleman, Pittsfield.	Mrs. Jesse H. Fairfield, Jr., Richmond.	Jesse H. Fairfield, Jr., Richmond.
Montgomery, No. 45,	Chas. A. Williams, Montgomery.	Rev. John H. Bigger, Russell.	Miss Agnes M. Moore, Montgomery.
Southwick, No. 46,	Solomon C. Warner, Southwick.	Mrs. Edith M. Trench, Southwick.	Nelson J. Trench, Southwick.
"Highland" of Huntington, No. 48,	Wilbert T. Moore, Huntington.	Miss Mae E. Warner, Huntington.	H. R. Gooch, Huntington.
"Granite" of South Worthington, No. 49,	Milo R. Bates, Ringville.	Mrs. Manley Stetson, So. Worthington.	Mrs. Emma Thurston, So. Worthington.
Sterling, No. 53,	Louis A. Stuart, Pratt's Junction.	W. A. Dingley, Pratt's Junction.	Mrs. W. A. Dingley, Pratt's Junction.
Springfield, No. 54,	E. T. Davis, Springfield.	Mrs. Sophia Carr, Springfield.	Miss Bertha E. Baker, Springfield.
Cummington, No. 56,	Ward A. Harlow, Cummington.	Chas. E. Clark, Worthington.	W. E. Ford, Cummington.
Auburn, No. 60,	Hosea J. Marcy, Auburn.	Wm. E. Prouty, Auburn.	Mrs. Eleanor W. Barrows, Auburn.
"Union" of Belchertown, No. 64,	F. L. Stebbins, Belchertown.	Geo. B. Jackson, Belchertown.	Mrs. E. A. Randall, Belchertown.
Brimfield, No. 65,	Cheney F. Newton, Brimfield.	Dr. Robert V. Sawin, Brimfield.	Chas. L. Pierce, Brimfield.
Charlemont, No. 66,	C. T. Haskins, Charlemont.	H. T. Warfield, Charlemont.	G. A. Grover, Charlemont.
Hardwick, No. 67,	W. A. Robinson, Hardwick.	Mrs. J. C. Paige, Hardwick.	John N. Hillman, Hardwick.
Shelburne, No. 68,	W. O. Long, Shelburne.	Mrs. D. R. Bardwell, Shelburne.	Geo. E. Taylor, Jr., Shelburne.
Ashfield, No. 69,	Albert Howes, South Ashfield.	Addison Graves, Shelburne Falls.	Miss Mary E. Sears, Ashfield.
Phillipston, No. 70,	A. D. Clifford, Phillipston.	Rev. I. A. Burnap, Phillipston.	Mrs. Lestina M. Goddard, Phillipston.
Leyden, No. 71,	C. F. Severance, Bernardston.	Mrs. J. K. Denison, Leyden.	Mrs. Gratia E. Campbell, Leyden.
"Prescott" of Pepperell, No. 73,	Frank T. Marston, East Pepperell.	Geo. A. Mahoney, East Pepperell.	Miss Minnie G. Dane, Pepperell.
Colrain, No. 76,	J. E. Davenport, Colrain.	Mrs. Geo. W. Cary, Colrain.	Miss Helen A. Peterson, Lyonsville.
Holden, No. 78,	T. W. Howe, Holden.	A. A. Metcalf, Holden.	Mrs. Ina M. Stanhope, Holden.
Spencer, No. 79,	Edward Warren, Spencer.	Geo. H. Larcom, Spencer.	J. W. Bigelow, Spencer.
"Manhan" of Southampton, No. 82,	Chas. S. Hooker, Holyoke.	H. D. Strong, Southampton.	Mrs. C. P. Gridley, Southampton.
North Orange, No. 86,	M. D. Herrick, North Orange.	Mrs. Mary Richardson, North Orange.	Mrs. Martha A. Cheney, North Orange.
Lee, No. 88,	H. E. Heebner, Lee.	C. H. Shaylor, Lee.	Mrs. H. J. Voght, Lee.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Charlton, No. 92,	Henry H. Baker, Charlton.	Miss Alice L. King, Dudley.	Mrs. Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	Edwin P. Goddard, Grafton.	Miss Anna C. Gibson, Grafton.	Miss Lula E. Whitney, Grafton.
Petersham, No. 95,	E. O. Coolidge, Petersham.	S. B. Cook, Petersham.	B. W. Spooner, Petersham.
Shrewsbury, No. 101,	Willis E. Knowlton, Shrewsbury.	Mrs. L. C. Knowlton, Shrewsbury.	Miss Georgie Bailey, Shrewsbury.
Stow, No. 103,	Geo. W. Bradley, Stow.	Mrs. Malvina Whitcomb, Stow.	Mrs. N. S. Lewis, West Acton.
"Garfield" of No. Dana, No. 104,	Lyman Randall, North Dana.	Dr. Ames W. Slate, North Dana.	Mrs. Lena M. Randall, North Dana.
Marlborough, No. 105,	R. H. Hapgood, Hudson.	Arthur A. Brigham, Marlborough.	Mrs. Elmer D. Howe, Marlborough.
West Boylston, No. 106,	Franklin E. Walker, West Boylston.	Wm. E. Parker, West Boylston.	Miss Hattie L. Goodale, West Boylston.
Millbury, No. 107,	Fred H. Rice, Worcester.	Miss Mabel L. Rice, Worcester.	Edw. P. Davidson, West Millbury.
Hudson, No. 108,	Geo. R. Osgood, Hudson.	Miss Mary S. Gay, Hudson.	Mrs. Mary E. Lawrence, Hudson.
Sutton, No. 109,	C. N. Woodbury, Sutton.	John E. Gifford, Sutton.	Miss Sarah M. Mills, Sutton.
Sherborn, No. 110,	L. D. Eames, Sherborn.	N. B. Douglas, Sherborn.	Mrs. G. L. Whitney, South Framingham.
Boylston, No. 111,	Geo. A. Hastings, Boylston Centre.	Miss Amy W. Kendall, Boylston Centre.	Mrs. Henrietta M. Andrews, Boylston Centre.
"East Medway" of Millis, No. 112,	J. H. Shannon, Millis.	F. H. Holland, Jr., Millis.	Chester LaCroix, Millis.
Framingham, No. 113,	Albert H. Wood, Framingham.	Harry B. Walkup, Framingham.	Luther M. Marston, Framingham.
Medfield, No. 114,	Wm. T. Herrick, Harding.	Fred H. Preston, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	Chas. Wilson, Metcalf Station.	Mrs. Lizzie S. Champney, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116,	Geo. W. Marsh, Westborough.	Arthur M. Nourse, Westborough.	Mrs. Nellie M. Guild, Westborough.
Dover, No. 117,	Joseph F. Ziolkowski, Dover.	Mrs. Inez M. Packard, Needham.	Georgiana Chamberlain, Needham.
Southborough, No. 118,	Paul S. Lincoln, Southville.	Mrs. Annie S. Taylor, Cordaville.	Mrs. Mary A. Klebes, Southborough.
Northborough, No. 119,	Clarence E. Buckley, Northborough.	Mrs. F. B. Hildreth, Northborough.	Miss Emma M. Cutler, Northborough.
Lancaster, No. 120,	E. T. Cunningham, Lancaster.	Mrs. E. T. Cunningham, Lancaster.	Miss Mary B. Evans, Clinton.
Sudbury, No. 121,	Miss Ida E. Goodnow, South Sudbury.	Mrs. Julia Ames, South Sudbury.	Mrs. Ida J. Rice, Maynard.
Templeton, No. 122,	E. B. Burnheimer, Templeton.	Mrs. E. B. Burnheimer, Templeton.	Mrs. R. S. Titterton, Templeton.
Oxford, No. 123,	D. M. Howe, Oxford.	Miss Alice M. Brady, Oxford.	Mrs. B. Grace White, Oxford.
Ashland, No. 124,	Herbert F. Wenzell, Ashland.	Miss Clara E. Cooper, Ashland.	Mrs. Lizzie F. Bennett, Ashland.
Upton, No. 125,	Edward B. Newton, Upton.	Wm. H. Wellington, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	Tyler S. Bishop, Hubbardston.	Mrs. Mabel J. Smith, Hubbardston.	Geo E. Morse, Hubbardston.

Amesbury, No. 127,	F. W. Sargent, Amesbury.	Miss A. W. Currier, Amesbury.	Miss Annie F. Tucker, Amesbury.
North Andover, No. 128,	W. S. Hughes, North Andover.	Lucy A. Prescott, North Andover.	Walter H. Hayes, North Andover.
Gardner, No. 130,	Robert E. Fisher, Gardner.	Miss Alice E. Munroe, Gardner.	Miss Mabel B. Cornwell, Gardner.
Boxborough, No. 131,	Albert Littlefield, West Acton.	Mrs. Albert Littlefield, West Acton.	Miss Amy Nelson, West Acton.
North Brookfield, No. 132,	Mrs. Frances A. Cummings, North Brookfield.	Mrs. J. Georgia Stoddard, North Brookfield.	Miss Clara A. Anderson, North Brookfield.
Berlin, No. 134,	Herbert L. Wheeler, Berlin.	Mrs. H. A. Wheeler, Berlin.	Mrs. L. W. Brewer, Berlin.
Norfolk, No. 135,	A. D. Towne, City Mills.	Miss Lillian Kilpatrick, Norfolk.	Mrs. Sarah B. Sims, Norfolk.
East Blackstone, No. 137,	Carleton Scott, Blackstone.	Mrs. Adelaide M. Stearns, Blackstone.	Adrian Scott, Blackstone.
Northampton, No. 138,	Wm. Phillips, Hadley.	Mrs. A. J. Morse, Northampton.	Miss Sarah E. Mason, Northampton.
East Sandwich, No. 139,	R. F. Armstrong, East Sandwich.	S. F. Crocker, Marston's Mills.	Geo. Parker, East Sandwich.
West Boxford, No. 140,	Timothy P. Clery, West Boxford.	Mrs. Alice M. Austin, West Boxford.	Miss Matilda B. Lund, West Boxford.
Montague, No. 141,	Chas. M. Hemenway, North Leverett.	Mrs. Laura A. King, Montague.	F. A. Rist, Sr., Montague.
Bolton, No. 142,	Rev. E. C. Headle, Bolton.	Mrs. A. L. Hunter, Bolton.	Miss Mary A. Otterson, Bolton.
Mendon, No. 143,	Leonard E. Taft, Mendon.	H. C. Adams, Mendon.	N. S. Hoagland, Mendon.
Franklin, No. 144,	Mrs. Maria Fisher, City Mills.	Mrs. Alice A. Duprez, Franklin.	Miss Alice V. Blake, Franklin.
Douglas, No. 145,	Simon P. Rawson, Douglas.	Miss Calla E. Foss, East Douglas.	Harrold A. Brown, East Douglas.
West Newbury, No. 146,	Chas. V. Tuxbury, West Newbury.	Mrs. Agnes Smith, West Newbury.	Miss Ada E. Colcord, West Newbury.
West Springfield, No. 147,	Homer B. Miller, West Springfield.	Alex Huth, West Springfield.	Miss Edith Sykes, West Springfield.
Concord, No. 150,	Arthur B. Worthly, Concord.	Mrs. Julia Hosmer, Concord.	Miss Bertha E. Foss, Concord.
Agawam, No. 151,	John G. Burt, Agawam.	Mrs. W. L. Phillips, West Springfield.	Mrs. Carrie L. Hayward, Agawam.
East Longmeadow, No. 152,	H. W. King, East Longmeadow.	Mrs. Cora B. Endicott, East Longmeadow.	E. L. Endicott, East Longmeadow.
Wilbraham, No. 153,	A. E. Mace, Wilbraham.	Mrs. M. R. Green, Wilbraham.	Mrs. L. E. Bosworth, Wilbraham.
Haverhill, No. 154,	G. Howard Smith, Haverhill.	Ira J. Webster, Haverhill.	Miss Elmina C. Gordon, Ayer's Village.
Methuen, No. 155,	Westley L. Messer, Methuen.	Frank A. Gordon, Methuen.	Mrs. Mary A. Crosby, Methuen.
West Bridgewater, No. 156,	E. B. Maglathlin, West Bridgewater.	E. Bradford Wilbur, West Bridgewater.	Miss Fannie R. Pratt, West Bridgewater.
Granby, No. 157,	Francis A. Forward, Granby.	Miss Carrie L. Dickinson, Granby.	Miss Rosabelle I. Blish, Granby.
"Nemasket" of Middleborough, No. 158,	Mrs. Annie D. Deane, Middleborough.	Mrs. Lizzie Sampson, Middleborough.	Mrs. John G. Paun, Middleborough.
South Hadley, No. 160,	I. N. Day, South Hadley.	Mrs. E. S. Johnson, Northampton.	Mrs. I. N. Day, South Hadley.
"Laurel" of West Newbury, No. 161,	Fred Stultz, West Newbury.	Mrs. Clara A. Kelso, West Newbury.	Geo. C. Thurlow, West Newbury.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Dartmouth, No. 162,	J. Frank Briggs, Dartmouth.	Hannah A. Briggs, Dartmouth.	J. H. Slocum, Dartmouth.
Dudley, No. 163,	Clifford D. Hall, Dudley.	Albert Hiscox, Dudley.	Dyer S. Elliott, Dudley.
Ware, No. 164,	Chas. W. Howard, Ware.	Mrs. Angie A. B. Butlington, Ware.	Frank W. Harwood, Ware.
Hampden, No. 165,	Mrs. G. T. Ballard, Hampden.	Mrs. C. H. Burleigh, Hampden.	J. W. Mulroney, Hampden.
Wellesley, No. 166,	Wm. D. Rudd, South Natick.	Mrs. Ida M. Keith, Wellesley Hills.	Mrs. Milton H. Parker, Wellesley.
Rowe, No. 167,	Henry D. Wright, Rowe.	Addison P. Goldthwait, Rowe.	Mrs. Anna L. Henry, Rowe.
Somerset, No. 168,	Chester B. Hathaway, Somerset.	Mrs. Abbie S. Sias, Fall River.	Mrs. Carrie L. Lewin, Pottersville.
Lunenburg, No. 169,	Fred H. Hadlock, Lunenburg.	Clayton E. Stone, Lunenburg.	James Hildreth, Lunenburg.
New Braintree, No. 170,	Edwin L. Havens, New Braintree.	Miss Mary F. Pollard, New Braintree.	Mrs. Ida M. Haven, New Braintree.
Merrimac, No. 171,	Chas. E. Hoyet, Merrimac.	F. E. Bartlett, Merrimac.	John J. Woodman, Merrimac.
Ashby, No. 172,	Chas. B. Shaw, Ashby.	Frank R. Pillsbury, Ashby.	Mrs. Ada A. Damon, Ashby.
Hopkinton, No. 173,	Geo. H. Mortimer, Woodville.	Mrs. Minnie E. Holcombe, Hopkinton.	Miss Sadie M. Mortimer, Woodville.
Brookfield, No. 174,	Mrs. Mary O. Lakin, Brookfield.	Mrs. Elbert Bemis, Brookfield.	Mrs. R. H. Hyde, West Brookfield.
Athol, No. 175,	Wm. G. Fuller, Athol.	Bertha J. Wood, Athol.	Sarah L. Smith, Athol.
"Miller's River" of Orange, No. 176,	Chas. H. Foskett, Orange.	Mrs. Louise Foskett, Orange.	W. C. Kidder, Orange.
Sturbridge, No. 177,	Bertram Chamberlain, Sturbridge.	Mrs. Fred E. Webster, Sturbridge.	Mrs. H. J. Ladd, Sturbridge.
Monson, No. 178,	F. D. Rogers, Monson.	Miss M. Esther Keep, Monson.	R. S. Stebbins, Monson.
Ludlow, No. 179,	E. N. Fisher, Ludlow.	Mrs. Bertha Taylor, Granby.	Mrs. Lizzie C. Chapman, Ludlow.
West Brookfield, No. 180,	Fred L. Woodard, West Brookfield.	Fred G. Smith, West Brookfield.	Mrs. Mary F. Holmes, West Brookfield.
Westport, No. 181,	Wm. E. Brightman, Central Village.	Miss Kittie Butterfield, Central Village.	C. R. Macomber, Central Village.
Southbridge, No. 182,	Jude T. McKinstry, Southbridge.	Miss May L. Stebbins, Southbridge.	Miss Adella Hare, Southbridge.
Andover, No. 183,	Edward W. Boutwell, Lowell.	John F. Knights, Andover.	Edward W. Burtt, Andover.
Topsfield, No. 184,	J. Arthur Lamson, Topsfield.	Chas. V. Jackman, Topsfield.	Mrs. Hattie E. Watson, Topsfield.
"Milton" of North Attleborough, No. 185,	Henry P. Caldwell, North Attleborough.	Mrs. Martha Caldwell, N. Attleborough.	Miss Ruth E. Hunt, Oldtown.
Fitchburg, No. 186,	Henry J. Andrews, Fitchburg.	Mrs. Ella Heywood, Fitchburg.	Herbert L. Hill, Fitchburg.
Littleton, No. 188,	Chas. F. Watts, Littleton Common.	Mrs. Clara G. Litchfield, Littleton Depot.	Miss Grace M. Needham, Littleton Common.

Warren, No. 189,	Fred N. Lawrence, West Warren.	Mrs. H. N. Shepard, Warren.	Mrs. Jennie M. Williams, Warren.
Bellingham, No. 190,	Edward H. Thayer, Bellingham.	Dr. N. W. Sanborn, Bellingham.	Wm. P. Greenwood, Milford.
"Chestnut Hill" of Blackstone, No. 191,	Justin Southwick, Blackstone.	Chas. Irons, Blackstone.	Selwyn Southwick, Blackstone.
Winchendon, No. 192,	Leslie B. Gregory, Winchendon.	Miss Gertrude Peak, Winchendon.	Chas. W. Brooks, Winchendon.
Foxborough, No. 193,	Mrs. Ada G. Mann, Foxborough.	O. P. Cook, Mansfield.	E. Clifton Allen, Foxborough.
Townsend, No. 194,	Geo. T. Powell, Townsend.	T. E. Flarity, Townsend.	Geo. A. Wilder, Townsend.
Royalston, No. 195,	Chas. A. Stimson, Athol.	Mrs. N. E. Ingerson, Royalston.	Chas. H. Brown, Royalston.
Easton, No. 196,	Joseph W. Baldwin, North Easton.	Mrs. F. F. Marshall, North Easton.	E. M. Drew, North Easton.
"Brookville" of Holbrook, No. 197,	Peter L. Vincent, Brookville.	Mrs. Irene White, Brookville.	Mrs. Fannie Hambley, Holbrook.
Leominster, No. 198,	Chas. Nutting, North Leominster.	Lion B. Ricketson, North Leominster.	H. D. Pratt, North Leominster.
Stoughton, No. 199,	John H. Smith, Stoughton.	Mrs. Ethel Bird, Stoughton.	E. H. Gilbert, Stoughton.
Uxbridge, No. 200,	Howard W. Phenix, Uxbridge.	Mrs. C. B. Davis, Millville.	Mrs. Kate Thom, Uxbridge.
Bridgewater, No. 201,	Lyman A. Pratt, Bridgewater.	Miss Sallie H. Davenport, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Walter E. Jefts, Ashburnham.	Miss Lilla E. Litch, Ashburnham.	Miss Mary E. Needham, Ashburnham.
Westminster, No. 203,	Wm. W. Sterlin, Westminster.	Mrs. Alice W. Sterlin, Westminster.	Fred G. Parcher, Westminster.
Rowley, No. 204,	Daniel H. O'Brien, Rowley.	Mrs. L. C. Bradstreet, Rowley.	J. A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Israel H. Hatch, North Marshfield.	Mrs. L. C. Flavell, Marshfield.	Francis T. Harlow, Marshfield.
Hanover, No. 206,	- - -	- - -	- - -
Tewksbury, No. 207,	A. C. Blaisdell, Wamesit.	Miss Ada Bridges, Tewksbury Centre.	Miss S. C. Whittemore, Tewksbury Centre.
Westford, No. 208,	W. M. Wright, Westford.	Walter J. Merritt, Coldspring.	Miss Flora Wright, Westford.
Hanson, No. 209,	Mrs. Joseph Holmes, North Hanson.	Herbert G. Cox, Hanson.	Miss Francella E. Bowker, Hanson.
Shawmut, No. 210,	Thomas A. H. Tefft, Shawmut.	Miss Jessie Wilber, Shawmut.	John L. Snell, Shawmut.
Chicopee, No. 211,	Chas. A. Perry, Chicopee.	Etta May Brill, Chicopee Falls.	Mrs. Lucinda M. Billings, Chicopee.
"Oak Hill" of Attleborough, No. 212,	O. S. Thayer, Attleborough.	Miss E. L. West, Attleborough.	Mrs. A. R. Lewis, Attleborough.
Walpole, No. 214,	Nathan W. Fisher, Walpole.	Edmund Grover, East Walpole.	Mrs. Annie E. Gay, Walpole.
Mattapoisett, No. 215,	Geo. A. Austin, Mattapoisett.	Frank B. Tuttle, Mattapoisett.	Alice W. Ashley, Mattapoisett.
Dracut, No. 216,	Calvin Richardson, Lowell.	Arthur W. Colburn, Dracut.	Miss Rose E. Peabody, Dracut.
Mansfield, No. 217,	Arthur S. Bolton, West Mansfield.	John C. Collins, Mansfield.	Mrs. Annie H. Bolton, West Mansfield.
Norton, No. 218,	Chas. T. Oldfield, Norton.	Miss Susan M. Barker, Norton.	Miss Laura F. Barker, Norton.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
East Princeton, No. 219,	Alfred O. Tyler, East Princeton.	Calvin A. Drury, East Princeton.	Mrs. Emilie A. Temple, East Princeton.
Sunderland, No. 220,	Milton H. Williams, Sunderland.	Mrs. Chester Warner, Sunderland.	Mrs. Martha A. Ward, South Deerfield.
"Anawan" of Rehoboth, No. 221,	Albert W. Cole, Hortonville.	Miss Bessie A. Carpenter, Rehoboth.	Mrs. Jennie M. Horton, So. Rehoboth.
Tyngsborough, No. 222,	James Danforth, Tyngsborough.	Miss C. Josephine Colburn, Tyngsborough.	C. F. K. Bancroft, Tyngsborough.
Billerica, No. 223,	Geo. P. Greenwood, Billerica.	Dr. Chas. E. Hosmer, Billerica.	Mrs. Cora L. Baker, Billerica.
Sheffield, No. 224,	Zaccheus H. Cande, Sheffield.	Mrs. Arthur I. Hoyt, Sheffield.	Roger M. Cande, Sheffield.
Williamsburg, No. 225,	Clinton B. Tower, Leeds.	Mrs. Marie Church, Williamsburg.	Henry W. Hill, Williamsburg.
West Medway, No. 226,	Norman B. Stone, West Medway.	John W. Zuver, West Medway.	Richard E. Gurney, West Medway.
Heath, No. 227,	Henry E. Stetson, North Heath.	Mrs. M. M. Mayhew, Dell.	Miss Mamie E. Maxwell, Heath.
Salisbury, No. 228,	James F. Chase, Salisbury.	Miss Elizabeth True, Salisbury.	Fred Kimball, Salisbury.
Cochituate, No. 229,	Chester B. Williams, Cochituate.	Rufus E. Corlew, Cochituate.	Mrs. Gertrude D. Bishop, Cochituate.
Taunton, No. 230,	Perley E. Davis, Taunton.	Chas. D. Lincoln, North Raynham.	Ernest A. Read, Taunton.

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PUBLIC DOCUMENT . . . . No. 33.

FIFTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1903.

BOSTON:
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1903.

Approved by

The State Board of Publication.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

OFFICERS.

Henry H. Goodell, LL.D.,	*Director.*
William P. Brooks, Ph.D.,	*Agriculturist.*
George E. Stone, Ph.D.,	*Botanist.*
Charles A. Goessmann, Ph.D., LL.D.,	*Chemist* (fertilizers).
Joseph B. Lindsey, Ph.D.,	*Chemist* (foods and feeding).
Charles H. Fernald, Ph.D.,	*Entomologist.*
Frank A. Waugh, M.S.,	*Horticulturist.*
J. E. Ostrander, C.E.,	*Meteorologist.*
Henry T. Fernald, Ph.D.,	*Associate Entomologist.*
Henry M. Thomson, B.Sc.,	*Assistant Agriculturist.*
Ralph E. Smith, B.Sc.,	*Assistant Botanist.*
Henri D. Haskins, B.Sc.,	*Assistant Chemist* (fertilizers).
Daniel L. Cleaves, B.Sc.,	*Assistant Chemist* (fertilizers).
James E. Halligan, B.Sc.,	*Assistant Chemist* (fertilizers).
Edward B. Holland, M.Sc.,	*First Chemist* (foods and feeding).
Philip H. Smith, B.Sc.,	*Assistant Chemist* (foods and feeding).
——— ———	*Assistant Chemist* (foods and feeding).
George A. Drew, B.Sc.,	*Assistant Horticulturist.*
——— ———	*Assistant Horticulturist.*
Stephen C. Bacon,	*Observer.*

The co-operation and assistance of farmers, fruit growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins and reports are still in stock and can be furnished on demand : —

No. 27. Tuberculosis in college herd ; tuberculin in diagnosis ; bovine rabies ; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 54. Fertilizer analyses.
No. 57. Fertilizer analyses.
No. 64. Analyses of concentrated feed stuffs.
No. 67. Grass thrips ; treatment for thrips in greenhouses.
No. 68. Fertilizer analyses.
No. 69. Rotting of greenhouse lettuce.
No. 70. Fertilizer analyses.
No. 72. Summer forage crops.
No. 73. Orchard experiments ; fertilizers for fruits ; thinning fruits ; spraying fruits.
No. 75. Fertilizer analyses.
No. 76. The imported elm-leaf beetle.
No. 77. Fertilizer analyses.
No. 78. Concentrated feed stuffs.
No. 79. Growing China asters.
No. 80. Fungicides ; insecticides ; spraying calendar.
No. 81. Fertilizer analyses ; treatment of barnyard manure with absorbents ; trade values of fertilizing ingredients.
No. 82. Orchard management ; cover crops in orchards ; pruning of orchards ; report on fruits.
No. 83. Fertilizer analyses.
No. 84. Fertilizer analyses.
Special bulletin, — The brown-tail moth.
Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Index, 1888–95.
Annual reports for 1897, 1898, 1899, 1900, 1901.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

An outline of the more important work undertaken and the results secured is all the limits of our space will allow. There have been no serious outbreaks of insects during the year. The gypsy moth and brown-tail moth have continued their ravages, while the elm-leaf beetle has been found more

particularly in the north-eastern part of the State. Extensive experiments on the best methods of treatment of the San José scale under New England conditions have been carried on. Six hundred trees have been under observation, and the results of different treatment have been verified by repeated investigations. A bibliographical catalogue of all the scale insects of the world is about completed and will soon be in press.

It has been found that to prevent the mildew on cucumbers grown under glass they should be started as late as possible in the season, and that a dry atmosphere in the house would largely prevent the spread of mildew. Apple-leaf spots were found not to be due to a fungus, as at first supposed, but to exposure to a freezing temperature and to subsequent cold, wet weather. The effect of spraying for leaf spot on linden and elm has been very marked, the foliage being more abundant and remaining green longer. So far as production of fruit is concerned, the experiment of planting cucumbers, watermelons and tomatoes on the edge of fields under tent cloth has proved a failure, because no provision was made for fertilizing the flowers. For sterilizing soil, two-inch pipe with three-sixteenths or one-fourth perforations gives better results than one-inch pipe. Sterilization of soil has marked beneficial results on germination of seeds and subsequent growth of plants; but tomato seeds seem to be an exception to this rule.

In addition to the regular work of the dairy division, with its 3,240 substances analyzed, 2,344 pieces of glass were tested for accuracy. Investigations have been on the following lines: (*a*) examination of butter fat in connection with feeding experiments, to note the effect of various feed constituents upon its character; (*b*) the improvement of methods for determination of the pentosans and starch in feed stuffs; (*c*) determination of the availability of organic nitrogen in fertilizing materials; (*d*) to ascertain the effect of two different milk-condensing processes on the nitrogenous bodies of milk. The pentosans were found to be fully as digestible as the other fodder groups in case of upland hays and most by-products, but rather less digestible in swale hay, salt

grasses and wheat bran. A mixture of winter wheat and sand or hairy vetch was found to be an early and desirable spring green fodder, but for the cost of vetch seed.

In the agricultural division, besides a carefully planned series of experiments to throw light on some of the numerous conditions determining productiveness, — chiefly as affected by different manures and fertilizers, either alone or in a wide variety of combinations, — variety tests with potatoes have been undertaken, with the result that in productiveness the following varieties stood first in the order given: Beauty of Hebron, I. X. L., Steuben, Early Nancy, Million Dollar, Ensign Bagley, Early Rose, Gem of Aroostook, and Daughter of Early Rose.

The details of the experiments thus briefly outlined may be found in the reports of the several divisions herewith submitted.

ANNUAL REPORT

Of George F. Mills, *Treasurer* of the Hatch Experiment Station of Massachusetts Agricultural College,

For the Year ending June 30, 1902.

Cash received from United States Treasurer,		$15,000 00
Cash paid for salaries,	$7,366 88	
for labor,	2,224 12	
for publications,	1,205 64	
for postage and stationery,	359 37	
for freight and express,	60 57	
for heat, light, water and power,	765 27	
for seeds, plants and sundry supplies,	530 60	
for fertilizers,	444 25	
for feed stuffs,	210 83	
for library,	140 53	
for tools, implements and machinery,	538 16	
for furniture and fixtures,	28 95	
for scientific apparatus,	59 24	
for live stock,	410 93	
for traveling expenses,	150 57	
for contingent expenses,	131 15	
for building and repairs,	372 94	
		$15,000 00

Cash received from State Treasurer,	$11,200 00	
from fertilizer fees,	3,405 00	
from farm products,	2,274 66	
from miscellaneous sources,	2,319 66	
		$19,199 32
Cash paid for salaries,	$11,966 73	
for labor,	2,012 21	
for publications,	406 36	
for postage and stationery,	321 22	
for freight and express,	132 93	
for heat, light, water and power,	639 40	
Amount carried forward,	$15,478 85	

	Amount brought forward, ...	$15,478 85	
Cash paid	for chemical supplies, ...	354 53	
	for seeds, plants and sundry supplies,	141 69	
	for fertilizers, ...	428 05	
	for feed stuffs, ...	784 50	
	for library, ...	143 87	
	for tools, implements and machinery,	87 05	
	for furniture and fixtures, ...	16 40	
	for scientific apparatus, ...	443 97	
	for live stock, ...	253 09	
	for traveling expenses, ...	437 45	
	for contingent expenses, ...	114 05	
	for building and repairs, ...	515 82	
			$19,199 32

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1902; that I have found the books well kept and the accounts correctly classified as above; and that the receipts for the year are shown to be $34,199.32, and the corresponding disbursements $34,199.32. All the proper vouchers are on file. These have been examined by me and have been found to be correct, there being no balance on accounts of the fiscal year ending June 30, 1902.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 26, 1902.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, JAMES E. HALLIGAN, DANIEL L. CLEAVES.

Part I. — Report on Official Inspection of Commercial Fertilizers.
Part II. — Report on General Work in the Chemical Laboratory.

Part I. — Report on Official Inspection of Commercial Fertilizers and Agricultural Chemicals during the Season of 1902.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 64; of these, 37 have offices for the general distribution of their goods in Massachusetts, 9 in New York, 8 in Connecticut, 3 in Vermont, 1 in Rhode Island, 3 in Canada, 1 in New Jersey, 1 in Maryland, 1 in Ohio and 1 in Illinois.

Two hundred and eighty-three brands of fertilizer, including chemicals, have been licensed in the State during the year. Five hundred and four samples of fertilizers have thus far been collected in the general markets by experienced assistants in the station.

Four hundred and fifty-one samples were analyzed at the

close of November, 1902, representing two hundred and seventy-three distinct brands of fertilizer. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 83, July; and No. 84, November, 1902.

From the above statement it will be noticed that there is a marked increase in the amount of work which is involved in the official inspection of commercial fertilizers from year to year. Four more manufacturers were recorded as having secured licenses for the sale of their goods in Massachusetts in 1902 than in the preceding year. Seventeen more brands of fertilizers were licensed and fifty-five more collected during the past season than in the previous year.

Below will be found an abstract of the results of analyses of official commercial fertilizers for the years 1901 and 1902: —

	1901.	1902.
(*a*) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	7	7
Number with two elements above the highest guarantee,	15	20
Number with one element above the highest guarantee,	51	83
Number with three elements between the lowest and highest guarantee,	142	183
Number with two elements between the lowest and highest guarantee,	91	87
Number with one element between the lowest and highest guarantee,	39	54
Number with three elements below the lowest guarantee,	–	3
Number with two elements below the lowest guarantee,	8	18
Number with one element below the lowest guarantee,	86	67
(*b*) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee,	7	10
Number with one element above the highest guarantee,	12	22
Number with two elements between the lowest and highest guarantee,	24	16
Number with one element between the lowest and highest guarantee,	14	13
Number with two elements below the lowest guarantee,	2	4
Number with one element below the lowest guarantee,	14	19
(*c*) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee,	7	9
Number between lowest and highest guarantee,	18	14
Number below lowest guarantee,	9	20

The quality of our commercial fertilizers for the past year has been fully as good as in the preceding years, and, with few exceptions, the commercial value of the fertilizer has

not suffered where a discrepancy has occurred between the results of analysis and the manufacturer's guarantee. This would indicate that it was the manufacturer's aim to furnish an article fully equal to his guarantee of composition, and, where a difference has occurred between the analysis and guarantee, that poor mixing is responsible for the discrepancy. It is self-evident that those fertilizers should be selected for general use which furnish the greatest amount of nitrogen, potash and phosphoric acid, in a suitable and available form, for the same money.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1901 and 1902 (Cents per Pound).

	1901.	1902.
Nitrogen in ammonia salts,	16.50	16.50
Nitrogen in nitrates,	14.00	15.00
Organic nitrogen in dry and fine-ground fish, meat, blood and in high-grade mixed fertilizers.	16.00	16.50
Organic nitrogen in fine bone and tankage,	16.00	16.00
Organic nitrogen in medium bone and tankage,	12.00	12.00
Phosphoric acid soluble in water,	5.00	5.00
Phosphoric acid soluble in ammonium citrate,	4.50	4.50
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and in ammonium citrate) in mixed fertilizers.	2.00	2.00
Potash as sulfate (free from chlorides),	5.00	5.00
Potash as muriate,	4.25	4.25

A comparison of the above trade values for 1901 and 1902 shows that the market cost of the different essential elements of plant food remains the same as in 1901, with the exception of nitrogen in form of nitrates and the higher grades of organic nitrogenous fertilizing materials, which show a somewhat higher cost, as compared with the previous year.

The trade values of fertilizing ingredients in raw materials and chemicals are based on the market cost, during the six months preceding March, 1902, of standard raw materials

which enter largely into the manufacture of commercial fertilizers found in our markets. The following is a partial list of such materials: —

Sulfate of ammonia.	Dissolved bones.
Nitrate of soda.	Acid phosphate.
Azotine.	Refuse bone-black.
Dried blood.	Ground phosphate rock.
Cotton-seed meal.	High-grade sulfate of potash.
Linseed meal.	Sulfate of potash and magnesia.
Bone and tankage.	Muriate of potash.
Castor pomace.	Kainit.
Dry ground fish.	Sylvinite.
Dry ground meat.	Crude saltpetre.

As definite instructions have been given from time to time regarding the calculation of the approximate commercial value of fertilizers, no attempt is here made for the discussion of that matter.

Table A, following, gives the average analysis of officially collected fertilizers for 1902; Table B gives a compilation of analyses of commercial fertilizers for the year 1902, showing the maximum, minimum and average percentages of the different essential elements of plant food in special crop fertilizers, so called.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1902.*

Nature of Material.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers,	11.14	2.29	2.10	4.57	3.57	2.06	10.64	9.29	8.03	7.37	4.96	4.69
Ground bones,	6.92	3.16	2.85	-	9.44	15.12	25.04	22.99	9.44	-	-	-
Tankage,	10.66	3.82	3.56	-	9.01	8.78	17.79	18.00	9.01	-	-	-
Dissolved bone-black,	11.06	-	-	10.16	5.24	1.97	17.68	16.00	15.71	15.00	-	-
Acid phosphate,	10.92	-	-	9.89	4.82	2.40	17.32	15.33	14.72	13.50	-	-
Wood ashes,	13.19	-	-	-	-	-	1.48	1.30	-	-	6.14	4.70
Cotton-seed meal,	7.11	6.48	6.75	-	-	-	-	-	-	-	-	-
Flax meal,	10.43	6.17	6.08	-	-	-	-	-	-	-	-	-
Nitrate of soda,	1.97	15.17	15.40	-	-	-	-	-	-	-	-	-
Sulfate of ammonia,	.82	22.02	19.00	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash,	.81	-	-	-	-	-	-	-	-	-	49.02	48.00
Low-grade sulfate of potash,	.23	-	-	-	-	-	-	-	-	-	25.85	26.00
Muriate of potash,	2.27	-	-	-	-	-	-	-	-	-	50.32	50.00
Kainit,	4.37	-	-	-	-	-	-	-	-	-	12.08	12.00

TABLE B. — *Compilation of Analyses of Commercial Fertilizers for the Year 1902.*

NAME OF FERTILIZER.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.			TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			POTASSIUM OXIDE IN ONE HUNDRED POUNDS.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	12.27	3.48	1.04	2.35	14.20	9.52	11.22	10.65	6.32	8.55	8.88	1.80	4.49
Fruit and vine fertilizer,	9.75	3.44	2.07	2.55	11.82	9.60	10.92	8.70	7.96	8.23	6.78	5.04	5.88
Grain fertilizer,	10.60	6.64	1.82	3.01	17.28	8.88	11.29	10.50	5.22	7.86	12.08	2.20	6.49
Grass fertilizer,	8.56	7.72	2.48	4.08	17.28	5.02	9.24	9.84	2.90	5.87	12.08	2.06	5.86
Market-garden fertilizer,	12.60	3.61	2.02	2.69	12.12	7.70	10.47	9.72	6.30	8.34	10.40	2.18	5.89
Potato fertilizer,	10.87	4.88	1.05	2.54	12.84	7.18	10.58	10.94	4.24	8.39	10.48	2.90	5.30
Tobacco fertilizer,	8.32	6.68	1.76	3.91	13.71	5.38	10.36	11.59	2.84	7.66	14.15	1.54	7.74

The writer wishes to call special attention to Table B, on the preceding page. A comparison of the results in this compilation of analyses of so-called special crop fertilizers reveals a wide difference between the maximum and minimum amount of nitrogen, phosphoric acid and potassium oxide claimed and found in the different brands of commercial fertilizers. In the different brands of tobacco fertilizers, for instance, there is a difference of 4.92 between the highest and lowest percentage of nitrogen, a difference of 8.75 between the maximum and minimum percentage of available phosphoric acid, and a difference of 12.61 between the mean and extreme percentage of potassium oxide which was found. A correspondingly great difference will be observed between the maximum and minimum percentages of plant food found in the several special crop fertilizers which have been compiled in the table. The average farmer is apt to lay too much stress upon the trade name of a fertilizer, and oftentimes buys an inferior article when guided wholly by the name under which it is sold.

There are many things to be taken into consideration in the judicious selection of a fertilizer for growing special crops. The physical and chemical character of the soil and sub-soil, the previous management of the soil and the system of crop rotation employed should all enter into consideration when selecting a fertilizer. A study of the soil should be made by simple local experiments with the different kinds and forms of plant food, to find what elements have become depleted; when these facts have become established, then supply the wants of the soil in the most suitable and economical manner. When the character of a soil is not known and its wants are not manifested, it is advisable to use a fertilizer more nearly corresponding to what a chemical analysis of the crop shows is required for its proper development. For the purpose of illustrating how the chemical composition of a crop may serve as a guide in the compounding of a commercial fertilizer, an example is here inserted. We find the average analysis of potatoes (see compilation of analyses of fruits, garden crops, etc., in annual report of this department for the year 1901) is as follows: —

	Parts per Thousand.
Phosphoric acid,	.70
Potassium oxide,	2.90
Nitrogen,	2.10

The relative proportion of phosphoric acid, potassium oxide and nitrogen present, according to this analysis, is: —

	Parts per Thousand.
Phosphoric acid,	1.00
Potassium oxide,	4.10
Nitrogen,	3.00

In other words, for every pound of phosphoric acid removed from the soil by a crop of potatoes there are 4.1 pounds of potassium oxide and 3 pounds of nitrogen removed. A fertilizer supplying the essential elements of plant food in this proportion would, therefore, under the above-stated conditions, be more suitable to use, as far as potassium oxide and phosphoric acid are concerned, as these elements are supplied only by the soil, while nitrogen is supplied in part by atmospheric sources.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1902, to May 1, 1903), and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- Nitrate of Soda.
- Muriate of Potash.
- High-grade Sulfate of Potash.
- Double Manure Salt.
- Dry Ground Fish.
- Fine-ground Bone.
- Dissolved Bone-black.
- Plain Superphosphate.
- Sulfate of Ammonia.
- Kainit.
- High-grade Fertilizer with Ten Per Cent. Potash.
- Tobacco Starter and Grower.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Bradley's X. L. Superphosphate.
- Bradley's Potato Manure.
- Bradley's Potato Fertilizer.

The American Agricultural Chemical Co. — *Con.*
- Bradley's Complete Manure for Potatoes and Vegetables.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.
- Bradley's Niagara Phosphate.
- Bradley's English Lawn Fertilizer.
- Bradley's Complete Manure with Ten Per Cent. Potash.
- Bradley's Complete Manure for Corn and Grain.
- Bradley's Complete Manure for Top-dressing Grass and Grain.
- Bradley's Grass and Lawn Top-dressing.
- Breck's Lawn and Garden Dressing.
- Brightman's Fish and Potash.
- Church's Fish and Potash.
- Bradley's Seeding-down Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer, G. G.
- Clark's Cove Potato Manure.
- Clark's Cove Potato Fertilizer.
- Clark's Cove Great Planet Manure.
- Clark's Cove King Philip Guano.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's Corn Phosphate.
- Crocker's New Rival Phosphate.
- Crocker's General Crop Phosphate.
- Crocker's A. A. Complete Manure.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
- Blood, Bone and Potash.
- Potato and Root Crop Manure.
- Complete Ten Per Cent. Manure.
- Potato Manure.
- Farm Favorite.

The American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's Complete Potato Manure.
- Baker's A. A. Ammoniated Phosphate.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
- Northern Corn Special.
- Grass and Oats Fertilizer.
- General Fertilizer.
- Garden Special.
- Vegetable Vine and Tobacco.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
- Pacific High-grade General.
- Soluble Pacific Guano.
- Pacific Potato Special.
- Pacific Nobsque Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
- Animal Corn Fertilizer.
- Potato Manure.
- Universal Fertilizer.
- Wheat, Oats and Clover Fertilizer.
- Gardener's Complete Manure.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
- Quinnipiac Onion Manure.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Corn Manure.
- Quinnipiac Market-garden Manure.
- Quinnipiac Havana Tobacco Fertilizer.
- Quinnipiac Climax Phosphate.
- Quinnipiac Potato Phosphate.
- Quinnipiac Dissolved Bone.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
- Read's Farmers' Friend.
- Read's Practical Potato Special.
- Read's Vegetable and Vine.
- Read's High-grade Farmers' Friend.
- Read's Standard.

The American Agricultural Chemical Co. (Standard Fertilizer Co., branch), Boston, Mass.: —
- Standard Fertilizer.
- Standard Guano.
- Standard Complete Manure.
- Standard Special for Potatoes.

The American Agricultural Chemical Co. (Henry F. Tucker Co., branch), Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Special Potato Fertilizer.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass.: —
- Williams & Clark's High-grade Special.
- Williams & Clark's Americus Phosphate.
- Williams & Clark's Potato Phosphate.

The American Agricultural Chemical Co. — *Con.*
- Williams & Clark's Corn Phosphate.
- Williams & Clark's Potato Manure.
- Williams & Clark's Royal Bone Phosphate.
- Williams & Clark's Prolific Crop Producer.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
- Corn Fertilizer.
- Potato Manure.
- Superior Truck Fertilizer.
- Bermuda Onion Grower.
- Grass and Oats Fertilizer.
- Havana Tobacco Fertilizer.

W. H. Abbott, Holyoke, Mass.: —
- Animal Fertilizer.
- Eagle Brand.
- Tobacco Fertilizer.

The Abbott & Martin Rendering Co., Columbus, Ohio: —
- Abbott's Tobacco and Potato Special.

The American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-seed Hull Ashes.

American Linseed Co., New York, N. Y.: —
- Cleveland Flax Meal.

Armour Fertilizer Works, Baltimore, Md.: —
- Blood, Bone and Potash.
- Ammoniated Bone with Potash.
- Grain Grower.
- All Soluble.
- High-grade Potato.
- Bone Meal.

H. J. Baker & Bro., New York, N. Y.: —
- Castor Pomace.

Bartlett & Holmes, Springfield, Mass.: —
- Animal Fertilizer.
- Pure Ground Bone.
- Tankage.

Berkshire Fertilizer Company, Bridgeport, Conn.: —
- Berkshire Complete Fertilizer.
- Berkshire Ammoniated Bone Phosphate.
- Berkshire Potato and Vegetable Phosphate.

Joseph Breck & Sons, Boston, Mass.: —
- Breck's Market Garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Potato and Vegetable Fertilizer.
- Bowker's Fish and Potash "Square Brand."
- Bowker's Potato Phosphate.
- Bowker's Sure Crop Phosphate.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Bowker's Superphosphate.
- Bowker's Ground Bone.
- Gloucester Fish and Potash.
- Dissolved Bone-black.
- Nitrate of Soda.
- Muriate of Potash.
- Sulfate of Potash.
- Dried Blood.
- Wood Ashes.
- Fine Dry Ground Fish.
- Bone, Blood and Potash.
- Fish and Potash D Brand.
- Bristol Fish and Potash.
- Corn Phosphate.
- Tobacco Ash Elements.
- Early Potato Manure.
- Sulfate of Ammonia.

Butchers' Rendering Co., Fall River, Mass.: —
- Tankage.

Chas. M. Cox & Co., Boston, Mass.: —
- Cotton-seed Meal.

E. Frank Coe Co., New York, N. Y.: —
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
- E. Frank Coe's Gold Brand Excelsior Guano.

E. Frank Coe Co. — *Con.*
- E. Frank Coe's Tobacco and Onion Fertilizer.
- E. Frank Coe's Bay State Phosphate.
- E. Frank Coe's F. P. Fish and Potash.
- American Farmers' Market Garden Special.
- American Farmers' Complete Potato.
- American Farmers' Corn King.
- Excelsior Potato Fertilizer.
- Columbian Corn Fertilizer.
- Columbian Potato Fertilizer.
- New Englander Corn Fertilizer.
- New Englander Potato Fertilizer.
- Columbian Bone Superphosphate.
- X. X. X. Ground Bone.
- Red Brand Excelsior Guano.

John C. Dow & Co., Boston, Mass.: —
- Dow's Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
- Imperial Liquid Plant Food.
- Imperial Liquid Grass Fertilizer.

Wm. E. Fyfe & Co., Clinton, Mass.: —
- Canada Unleached Hard-wood Ashes.

R. & J. Farquhar & Co., Boston, Mass.: —
- Clay's London Fertilizer.

Thomas Hersom & Co., New Bedford, Mass.: —
- Meat and Bone.
- Bone Meal.

F. E. Hancock, Walkerton, Ontario, Can.: —
- Pure Unleached Hard-wood Ashes.

The Hardy Packing Co., Chicago, Ill.: —
- Hardy's Tankage, Bone and Potash.
- Hardy's Tobacco and Potato Special.
- Hardy's Complete Manure.

C. W. Hastings, Cambridgeport, Mass.: —
- Ferti Flora.

John Joynt, Lucknow, Can.: —
- Pure Canada Unleached Hard-wood Ashes.

Thomas Kirley & Co.'s Fertilizer Works, South Hadley Falls, Mass.: —
- Pride of the Valley.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Lister's Success Fertilizer.
- Lister's Special Corn and Potato Fertilizer.
- Lister's High-grade Special for Spring Crops.
- Lister's Animal Bone and Potash.

Lowell Fertilizer Co., Boston, Mass.: —
- Swift's Lowell Bone Fertilizer.
- Swift's Lowell Potato Phosphate.
- Swift's Lowell Market Garden.
- Swift's Lowell Tobacco Manure.
- Swift's Lowell Potato Manure.
- Swift's Lowell Animal Brand.
- Swift's Lowell Fruit and Vine.
- Swift's Lowell Dissolved Bone and Potash.
- Swift's Lowell Ground Bone.
- Nitrate of Soda.
- Muriate of Potash.
- Swift's Lowell Lawn Dressing.
- Acid Phosphate.

McQuade Bros., West Auburn, Mass.: —
- Ground Bone.

Geo. L. Munroe, Oswego, N. Y.: —
- Pure Canada Unleached Hard-wood Ashes.

Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
- Potato Manure.
- Tobacco Starter improved.
- Tobacco Manure Wrapper Brand.
- Fruit and Vine Manure.
- Economical Potato Manure.
- Average Soil Complete Manure.
- Vegetable Manure or Complete Manure for Light Soils.
- Corn Manure.
- Complete Manure "A" Brand.
- Cereal Brand.
- Complete Manure Ten Per Cent. Potash.
- Complete Manure for General Use.

Mapes Formula and Peruvian Guano Co. — *Con.*
- Cauliflower and Cabbage Manure.
- Lawn Top-dressing.
- Grass and Grain Spring Top-dressing.
- Top-dressing improved, One-half Strength.

National Fertilizer Co., Bridgeport, Conn.: —
- Chittenden's Complete Fertilizer.
- Chittenden's Market Garden.
- Chittenden's Potato Phosphate.
- Chittenden's Fish and Potash.
- Chittenden's Ammoniated Bone.
- Chittenden's Universal Phosphate.

New Bedford Product Co., New Bedford, Mass.: —
- Tankage.

New England Fertilizer Co., Boston, Mass.: —
- Corn Phosphate.
- Potato Fertilizer.
- Seeding-down Fertilizer.

Olds & Whipple, Hartford, Conn.: —
- Complete Tobacco Fertilizer.
- Vegetable Potash.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
- Plymouth Rock Brand.
- Special Potato.
- Star Brand.
- P. & P. Potato.
- A. A. Brand.
- Pure Ground Bone.
- Nitrate of Soda.
- Muriate of Potash.

Benjamin Randall, Boston, Mass.: —
- Market Garden.
- Farm and Field.

Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Pure Raw Knuckle Bone Flour.
- Hubbard's Strictly Pure Fine Bone.
- Hubbard's Oats and Top-dressing.
- Hubbard's Soluble Potato Manure.
- Hubbard's Corn and General Crops.
- Hubbard's Soluble Tobacco Manure.
- Hubbard's Grass and Grain Fertilizer.
- Hubbard's All Soils and All Crops Fertilizer.
- Hubbard's Potato Phosphate.
- Hubbard's Corn Phosphate.
- Hubbard's '02 Top-dressing Phosphate.

Rogers Manufacturing Co., Rockfall, Conn.: —
- All Round Fertilizer.
- Complete Potato and Vegetable.
- Complete Corn and Onion.
- Complete Fish and Potash.
- High-grade Grass and Grain.
- High-grade Tobacco and Potato.
- High-grade Oats and Top-dressing.
- High-grade Soluble Tobacco.
- Pure Fine Ground Bone.

Russia Cement Co., Gloucester, Mass.: —
- Essex Dry Ground Fish.
- Essex Complete Manure for Potatoes, Roots and Vegetables.
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Market Garden and Potato Manure.
- Essex A. L. Superphosphate.
- Essex X. X. X. Fish and Potash.
- Essex Odorless Lawn Dressing.
- Essex Special Tobacco Manure.
- Essex Tobacco Starter.
- Essex Corn Fertilizer.

Chas. Stevens, Napanee, Ontario, Can.: —
- Beaver Brand Ashes.

Salisbury Cutlery Handle Co., Salisbury, Conn.: —
- Fine Bone.

Sanderson's Fertilizer and Chemical Co., New Haven, Conn.: —
Sanderson's Old Reliable.
Sanderson's Formula A.
Sanderson's Formula B.
Sulfate of Potash.

Thomas L. Stetson, Randolph, Mass.: —
Bone Meal.

J. Stroup Son & Co., Boston, Mass.: —
Canada Hard-wood Unleached Wood Ashes.

Jas. P. Trainor, Jamesville, Mass.: —
Pure Ground Bone.

Darius Whithed, Lowell, Mass.: —
Champion Animal Fertilizer.
Flour of Bone.

The Whitman & Pratt Rendering Co., Lowell, Mass.: —
Whitman & Pratt's Potato Plowman.
Whitman & Pratt's Corn Success.
Whitman & Pratt's Pure Ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.: —
Complete Bone Superphosphate.
Potato Manure.
Fish and Potash.
High-grade Tobacco Fertilizer.
Dry Ground Fish.

Sanford Winter, Brockton, Mass.: —
Pure Fine-ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
Tankage.

Part II. — Report on General Work in the Chemical Laboratory.

CHARLES A. GOESSMANN.

1. Analysis of materials sent on for examination.
2. Notes on wood ashes.

1. Analysis of Materials sent on for Examination.

During the season of 1902, 217 samples of fertilizing materials, soils, etc., have been received from farmers within our State. The results of analysis of these substances have been published, when deemed of importance to the general public, in three bulletins: No. 81, March; No. 83, July; and No. 84, November, 1902, of the Hatch Experiment Station of the Massachusetts Agricultural College.

Nearly every manufacturing industry has its by-products, which have often a distinct value for manurial purposes. The use of this class of materials has been encouraged whenever the chemical analysis of the same proves them to be of sufficient value to merit their use. The investigation of general fertilizing material of this nature is carried on free of charge to farmers in the State: the material is taken up for analysis in the order of arrival of samples at this office. We have advised farmers to send material for free analysis as early in the season as possible, as work of this nature has to be suspended during the rush of official inspection work during the spring and summer months. Following is a list of materials received during the past season: —

Wood ashes,	52	Dry ground fish,	10
Miscellaneous material,	25	Ground bones,	6
Soils,	35	Onions,	8
Complete fertilizers,	22	Natural phosphates,	6

Cotton-seed meal,	4	Castor pomace,	1
Horn dust,	3	Sulfate of potash,	1
Mill waste,	2	Hemp ashes,	1
Wool waste,	3	Air-slaked lime,	1
Sheep manure,	2	Nitre lime,	1
Tankage,	2	Nitrate of soda,	1
Barnyard manure,	2	Low-grade sulfate of potash,	1
Acid phosphate,	2	Dissolved bone-black,	1
Carbonate of potash,	2	Muriate of potash,	1
Lime ashes,	2	Sulfate of ammonia,	1
Paris green,	1	Mold from compost pile,	1
Basic slag,	1	Waste ashes,	1
Pulverized rock weed,	1	Burned bone,	1
Coral formation,	1	Turf,	1
Leaf mold,	1	Tan-bark ashes,	1
Peat,	1	Brick-yard ashes,	1
Vegetable potash,	1	Sizing paste,	1
Tobacco stalks,	1	Sewage,	1
Cotton-hull ashes,	1	Acetylene tank refuse,	1
Celery plant,	1		

As in the past, we have collected and analyzed samples of Paris green and other insecticides found in our general markets. The analysis of these materials will be found in our March bulletin, No. 81, for 1902.

We have been engaged in work for the Association of Official Agricultural Chemists, to assist in the selection of the best methods of analysis of insecticides, etc., and have taken up co-operation work for the association on new methods of potash determination. The results of this work do not appear in our publications, the work being of technical nature, and of value only to the Association of Official Agricultural Chemists in the establishment of new methods of analysis.

We are constantly occupied with investigations of new methods for the determination of the available plant food in soils, and new and improved methods for the ash analysis of plants, and have been to considerable expense in procuring the equipment for the latter work, being obliged to import most of the apparatus from Germany. The equipment con-

sists of a power mill (*Kugelmuhle*) to be used in the preparation of the plant for analysis, and which eliminates all danger of the contamination of the sample with iron or other metallic substances, the grinding being accomplished by means of porcelain balls revolving within a tightly sealed porcelain vessel. In this connection we have imported suitable platinum apparatus, recommended by Wislicenus, Tollens and others, for the purpose of securing the ashes of plants at a low temperature; its structure being such as to eliminate all danger of the volatilization of potash, soda, phosphoric acid and other mineral constituents of plants. Attention has also been directed to the investigation of the available phosphoric acid in natural phosphates. The results of investigations above mentioned will be published from time to time, whenever the results prove of general interest and value to the public.

2. Notes on Wood Ashes.

During the season of 1902, 24 per cent. of the materials forwarded for analysis consisted of wood ashes. The following table shows their general chemical character: —

Analysis of Wood Ashes.	Number of Samples.
Moisture below 1 per cent.,	2
Moisture from 1 to 10 per cent.,	18
Moisture from 10 to 20 per cent.,	22
Moisture from 20 to 30 per cent.,	6
Potassium oxide from 7 to 8 per cent.,	4
Potassium oxide from 6 to 7 per cent.,	8
Potassium oxide from 5 to 6 per cent.,	21
Potassium oxide from 4 to 5 per cent.,	12
Potassium oxide from 3 to 4 per cent.,	2
Potassium oxide below 3 per cent.,	1
Phosphoric acid from 1 to 2 per cent.,	46
Phosphoric acid below 1 per cent.,	2
Average per cent. of calcium oxide (lime),	32.18
Insoluble matter below 10 per cent.,	15
Insoluble matter between 10 and 15 per cent.,	17
Insoluble matter between 15 and 20 per cent.	13
Insoluble matter above 20 per cent.,	3

The average standard of this class of materials remains about the same as in previous years.

Farmers have been advised to patronize dealers and importers of wood ashes who are on record at our institution as having complied with our State laws and secured licenses for the sale of their article in Massachusetts, for only in such cases is a protection by our State laws possible. We have also urged them to state in every case the particular source from which the materials forwarded for free analysis have been derived.

REPORT OF THE HORTICULTURIST.

F. A. WAUGH.

During the year the work of the division of horticulture has been extensively reorganized. These changes have been necessitated partly by new conditions and partly by a change in the administration of the division. The principal innovations are three, as follows: —

1. The abandonment of miscellaneous variety tests, and the substitution, in their place, of systematic studies of varieties from all sources and under all conditions.

2. The establishment of definite lines of experiment designed to develop the principles underlying the practice of fruit and vegetable culture.

3. The opening of an extensive system of permanent records, which are expected to hold together the work of successive years, to assist in the interpretation of current observations by offering a comparison with previous results, to make possible the accumulation of comparable data through a period of years, to make the results of experiments at all times available, and, in general, to secure definiteness of aim, clearness of interpretation and consectivity of work in all the experimental operations of the division.

There is no need of publishing at this time a full programme of the experimental work already determined on. It may be proper to say, however, that the work is planned to cover certain important practical problems in the propagation and cultivation of orchard fruits, particularly apples, peaches and plums, and similar investigations in the culture of small fruits and vegetables.

As has been the practice hitherto, every effort will be made to furnish prompt and reliable information in response to the many inquiries which are sent in from day to day.

REPORT OF THE BOTANISTS.

GEORGE E. STONE, RALPH E. SMITH.

Plant Diseases in 1902.

Diseases affecting cultivated plants have, as usual, caused more or less damage during the past season. The following pages describe briefly the occurrence of the most important.

Peach-leaf Curl (*Exoascus deformans*).

This fungus was rather more prevalent than usual early in the season. Its effects were most noticeable upon young trees, particularly upon Elberta and Crosby, these varieties being attacked to the exclusion of others in the same orchards. Though very destructive in many portions of the country, it is not commonly a serious one in Massachusetts.

Apple-leaf Spot.

One of the most noticeable troubles of the season has been the injury to apple foliage caused by frost, which is described elsewhere in this report. Many trees, after the spotting and yellowing of the leaves early in the season, were quite denuded by midsummer. Well-cared-for trees were not often affected, so that the actual damage from this source was probably very slight.

Sycamore Blight (*Glœosporium nervisequum*).

This disease was, as usual, very severe, causing the fall of almost all the leaves on sycamore trees during June and July.

Strawberry Root Rot.

This apparently new trouble of the strawberry plant (see p. 34) was much complained of in new beds set out this season.

Apple Scab (*Fusicladium dendriticum*).

Both early and late apples were badly affected by scab during the year, except on high ground.

Cucumber Wilt.

This bacterial disease was more prevalent than ever before in large cucumber fields, and is evidently on the increase, though no great damage resulted this year.

Sweet Pea Troubles.

The cool, moist summer proved very favorable to the growth of this plant, and much less trouble than for several years was experienced by large growers. The "shelling" of the buds and blossoms, brought on by close, muggy weather, occurred somewhat; but the blight of the vines, so common and destructive of late, appeared very little this season.

Aster Diseases.

The "yellow" disease of this plant was noticeably less abundant than usual this year, its prevalence being evidently influenced by the character of the season. The wilt or stem rot proved very destructive in many plants started in the greenhouse, while those grown entirely out of doors were comparatively free from its attack.

Potato Blight (*Phytophthora infestans*).

This disease came on somewhat later than usual, being retarded by cool weather early in August. It soon became prevalent, however, and rotting of the tubers was unusually severe, the crop being greatly diminished.

Cucumber and Melon Diseases.

These plants suffered greatly during the season from a variety of causes, chief among which was the downy mildew (*Plasmopara cubensis*), the unusual prevalence of which is described more fully elsewhere in this report. The *Alternaria* disease and anthracnose were also common. Muskmelons were a total failure everywhere, and cucumbers were

considerably injured. The cold, wet season proved very unfavorable to the melon crop, so that the vines readily succumbed to disease.

Asparagus Rust (*Puccinia Asparagi*).

Asparagus plants were affected by rust much less than in previous years, demonstrating the influence of conditions of weather upon this disease.

Chrysanthemum Rust (*Puccinia Hieracii*).

The destructiveness of this disease, which has seriously threatened the chrysanthemum, is evidently declining. Cases of its occurrence have been very few this season, and no serious damage has been evident.

The Cucumber Mildew in Massachusetts (*Plasmopara Cubensis* (B. & C.) Humph.).

The general occurrence of this disease during the past season upon cucumbers and melons calls attention to its peculiar history in this State. The fungus was described from Cuba many years ago, but was discovered in this country in 1889, when it appeared in Massachusetts, New Jersey and other States at about the same time. In the report of the Massachusetts Experiment Station for 1889, Dr. Humphrey, then of this division, noted the occurrence of the disease, calling attention to the serious damage which its general distribution might cause. In subsequent years this mildew became very prevalent throughout the southern and middle States, causing great damage each year to cucumbers and melons as far north as Long Island, but not in New England. From this limited distribution it appeared that the fungus required a somewhat warmer climate than ours for its normal development.

In the autumn of 1900 the downy mildew appeared again in this State, being found upon greenhouse cucumbers in two different localities, as noted in the report of this division for that year. These were the only cases known at that time. The next season the muskmelon crop all over the State was quite generally affected and destroyed by this fungus, which

also occurred abundantly upon greenhouse cucumbers, but was not observed upon the latter plant when grown out of doors. During the past season (1902) muskmelons have been almost a total failure from this cause; and cucumbers, both in and out of doors, have been generally affected, the fungus being abundant everywhere upon these two plants.

Thus it appears that for the past three years this fungus has been steadily increasing in its distribution. Its most serious effects in this State have been upon the muskmelon. Scarcely a single melon was obtained this year by most of the growers, the vines being killed completely within a few days' time. Experiments in spraying, made in co-operation with this division in several different places, have shown but little gain. It seems quite evident, in fact, that so long as this disease continues to prevail the muskmelon cannot be grown in Massachusetts. The plant is not naturally adapted to our climate, and succeeds at best only in favored localities. When attacked by disease it succumbs very easily, especially in such an unfavorable season as the past one has been.

Upon the cucumber, the disease, while general, is as yet by no means as serious. Out-of-door fields showed the fungus everywhere this year, but the vines remained alive for some time, and the yield did not appear to be seriously diminished. This, however, is but one year's experience.

The effect of this disease upon greenhouse cucumbers is perhaps the most important consideration of the whole subject. Here is an industry of considerable and very rapidly increasing importance in this State, involving, relative to most other agricultural industries, a large amount of capital. It is one in which success means good profits and failure large losses. No serious obstacle which cannot be overcome has as yet been met with, but considerable alarm has been caused by the general appearance of the downy mildew. It may be said, however, that thus far no great damage has been evident. It is noticeable that the disease is most serious in the greenhouse upon plants started in August, which is the time of its occurrence out of doors. Those started later in the season or in spring do not seem to suffer. Even when present in the house, the disease does

not kill the vines outright, and by picking off the affected leaves growers have succeeded in keeping it considerably in check. It is therefore recommended that greenhouse cucumbers be started as late as possible, to avoid the mildew. Plants started in October have not shown the disease, where those planted in August were badly affected. This is the safest and easiest preventive. In case this is impracticable, on account of an early crop being desired, a dry atmosphere in the house will largely prevent the spread of the mildew, the development of which is favored by atmospheric moisture. By removing affected leaves, and keeping the house dry, the disease can be effectually kept down. A third remedy lies in spraying, which must be resorted to with an early crop in moist atmosphere. This has been practised very successfully with out-of-door cucumbers upon Long Island, using the Bordeaux mixture. Spraying can be done thoroughly in the greenhouse, and both sides of the leaves should be well covered.

The Muskmelon Blight.

On account of the general prevalence and general destructiveness of this disease, melon growing has become practically impossible in Massachusetts. This plant, as described in our last report, has become affected worse and worse each year with several different fungous diseases, the attacks of which its delicate nature has little power to resist. The chief trouble this year and last has been the downy mildew, in connection with which the anthracnose and *Alternaria* disease have also developed. The cold weather of the last season was very unfavorable for muskmelons, making it almost impossible to get vigorous plants started. Those started in-doors and transplanted made practically no growth for weeks after being set out, and fell an easy prey to disease. The *Alternaria* disease appeared about July 15, but appeared to cause no immediate damage; but the mildew, coming on in the latter part of August, killed the vines completely all over the State, and no returns whatever were received from many large fields. After these two years of complete failure since the mildew appeared, it is probable

that but few attempts will be made in the near future to grow this crop.

The subject of spraying as a preventive for this trouble has received considerable attention from this division for several years. During the past season experiments were made in co-operation with a local grower along the lines which previous experience had suggested. The details of this work will be reserved for a bulletin; but it may be said here that, even where plants were thoroughly sprayed with Bordeaux mixture, commencing early in July when the first leaves developed, no effect could be seen upon the development of the mildew. Sprayed and unsprayed plots and fields were alike a complete failure. It therefore seems quite evident that, so long as this disease continues to prevail, the muskmelon cannot be grown here under ordinary treatment. In seasons favorable to the plant, persistent spraying with good culture may give some returns; but in a poor year the crop is almost sure to be a failure, in spite of anything which can be done to save it. The plant is too poorly adapted to our climate to withstand a serious disease.

An Apple-leaf Spot.

One of the most frequent subjects of inquiry of this division during the past summer was a spotting and dying of apple leaves, which occurred very generally in this and other States. The trouble was first noted in May or early June, when trees affected showed a spotting of the leaves resembling a fungous leaf spot. This occurred quite generally, but usually on trees in pastures and by roadsides, rather than in well-kept orchards. The spotting was also more evident on low, frosty ground. With the advance of the season the spotting became much more marked, the foliage gradually turning yellow and dropping from the trees. This became very noticeable and caused considerable alarm, being in striking contrast to the usual healthy condition of apple foliage. Good orchard trees were in few cases seriously affected, though in some the spotting came on rather late in the season. The trouble prevailed mostly in neglected trees growing under unfavorable conditions; most of these lost their leaves during the summer.

Investigation of affected leaves failed at all times to show any fungus or other organism which could be regarded as the cause of the spotting, but revealed peculiarities which point to a cause of quite a different nature; namely, the occurrence of freezing temperature and frost at the time the leaves were unfolding, and subsequent cold, wet weather to an unusual extent throughout the season. At the time when apple trees were leaving out, a period of very low temperature came on, with frost and ice. Immediately following this the first spotting of the leaves appeared, being most noticeable in the most frosty places. Affected leaves showed numerous dead spots, especially near the veins, where would be the largest amount of water. In these spots the tissue was dead and ruptured. No organism was to be found as the cause of the injury, and from the sequence of events there could be no reasonable doubt that the frost was the destructive agency. As the season progressed, these leaves gradually dropped off, as might be expected. Further than this, however, the spotting of the leaves gradually increased through the summer, so that in the latter part of the season trees were affected which had not shown the trouble at first, while those originally affected lost almost all their leaves. This at first sight seemed to render it impossible that the trouble was due to the spring frost, since much of the spotting did not appear until August, particularly in well-cared-for orchards. In all these cases, however, the injurious effects were undoubtedly due to the same original cause. Careful microscopic examination of leaves when first affected showed not only the actual dead spots, but also many other portions affected in a peculiar manner. Here and there on the leaf could be found minute, blister-like spots, retaining at first the natural green color. In these places freezing had evidently occurred, causing more or less mechanical injury to the tissues, but not sufficient to cause immediate death. The epidermis became separated from the underlying cells, and more or less ruptured. In such spots, apparently, originated the trouble manifested later in the summer. The weather, being abnormally wet and cold, produced a low state of vitality, so that the tissue gradually died away in these injured places, and visible dead spots

appeared. Orchard trees in good condition were perhaps less affected in the first place, and subsequently were better able to withstand the injury, owing to their better condition. This trouble is an unusual one, of more interest on account of its peculiar nature than from any economic importance.

A Strawberry Disease.

Many complaints were made during the past summer of the dying of strawberry plants set out in new beds. The same also occurred to a much less extent in old beds at the time of fruiting. In the latter case the trouble appeared as a withering and dying of the fruit stalks, followed by the same effect in the leaves. Much more pronounced was the case of the new beds, where in numerous instances many of the young plants withered away in July, showing symptoms of a very definite nature. The first indications of the disease appeared in the leaf stalks, which showed a dark discoloration and withering. Following this the leaves slowly faded away, the whole plant finally becoming dead. The trouble at first sight appeared to be located in the petioles, where the black spots first appeared. Examination of these parts, however, showed no fungus present, nor anything which would account for the effect. The roots of affected plants were found in all cases to be in very poor condition, the older ones being decayed and little new growth present, as should be the case where the plants had been set out some time. Further examination showed that a fungous growth was present in almost all the roots of affected plants, apparently causing them to rot away at the ends. Even in the sound parts this fungus could be detected, growing in from the outside toward the centre. In affected plants from many different localities the same condition was found, so that there can be little doubt that the withering of the petioles and leaves was due to the rotting of the roots. Attempts were made to obtain cultures of the fungus, in order to determine its identity more definitely and test its effect upon healthy plants. As this was not accomplished, no definite conclusions can be drawn as to the actual cause of the disease. The cold, wet weather of the past season would nat-

urally tend to aggravate a trouble of this nature, but its general and characteristic occurrence indicates the presence of a more definite cause than this. Should the disease continue to prevail, care should be taken in starting new beds to propagate only from healthy, vigorous plants.

Plum "Yellows."

A disease apparently similar to the "yellows" of the peach has been noticed for several years upon the college grounds. It occurs only upon the Japanese varieties, particularly the Abundance, and is as yet of no serious consequence. The trouble is characterized by the production of wiry yellow shoots, just as in the peach yellows.

Spraying of Linden and Elm Trees for Leaf Spot.

Both of these shade trees are frequently affected with leaf-spot fungi, which sometimes becomes quite abundant, causing the leaves to fall prematurely. Some lindens on the college grounds become badly affected each year with leaf spot (*Cercospora microsora*), while other much younger trees show little or no trace of it. The older, infected trees are also more or less injured by borers, and many of the younger trees show the effects of sun scald on their trunks. The presence of the leaf spots on the older trees in such abundance is probably secondary, *i.e.*, the trees are in such poor condition they induce leaf spot to thrive. Elms are not so badly affected with the leaf spot (*Dothidella ulmea*) as lindens with the *Cercospora*. Some lindens and elms were sprayed twice this summer, viz., July 12 and August 13. The result of this spraying was very marked. The sprayed linden trees could be easily identified by any one during September and October, on account of the more abundant foliage and greener color of the leaves. The foliage remained on the sprayed trees some days longer than on the unsprayed ones. While the sprayed trees were affected to some extent with the spot fungus, there was a decided difference in the amount of infection between the treated and untreated. Better results would undoubtedly have been obtained if

the lindens had been sprayed earlier, or about July 1, as at the time of the first spraying the spot was beginning to appear.

None of the elm trees, either the sprayed or unsprayed, developed much of the leaf spot. All that can be said in favor of the sprayed trees is that their foliage remained green longer than the other trees, and the trees retained their leaves the latest of any. We estimate that linden trees affected as these were, if sprayed twice during the season, would result in a gain of from two to five per cent. in their growth and development. The cost of spraying was insignificant, as the trees were not large. The question involved in all such instances is, whether the tree is worth the expense. This depends on the owner's interest in such matters, and in the means and facilities to have such work done.

Crops under Tent Cloth.

Much interest has been manifested in Massachusetts and Connecticut in the last two or three years in growing Sumatra tobacco under tent cloth. That the environmental conditions of plants are greatly modified under tent cloth is well known. Besides exerting a characteristic influence on the texture of the plants, we might expect, from our knowledge of the conditions which favor fungous infection, that the conditions prevailing under tent-cloth culture would result in producing in certain cases beneficial results. In some instances tobacco growers have planted cucumbers, watermelons, tomatoes, etc., on the border of tobacco beds planted under tent cloth, largely as a matter of curiosity, to see how they would develop under these conditions. So far as the production of fruit is concerned, it may be stated that these experiments have been a failure, because no adequate provision was made to fertilize the flowers. As a result of this, plenty of fruit set but did not mature. The foliage of watermelons which was observed under tent cloth was in excellent condition. We noticed, however, on a few vines about a dozen leaves affected with *Alternaria*, which, however, showed no tendency to spread. Muskmelons developed good vines and foliage, but towards the latter part

of the season they showed some of the usual blights. The foliage of tomato plants which we observed was absolutely perfect, there being no trace of the flea beetle or *Macrosporium*. None of the crops developed any fruit of any consequence. The melons, etc., should have been provided with bees to fertilize the flowers, and the tomatoes should have been shaken frequently, to accomplish the same purpose. Cucumbers did well, but failed on account of bees to set fruit. It is generally agreed by growers that the foliage produced under tent cloth was of superior quality, though, on account of the inability of the crops to set fruit, they were considered a failure. The foliage of geraniums and other decorative plants was excellent, and the geraniums showed no tendency to a leaf spot which had been rather abundant during the past summer. Our experiments in growing muskmelons under glass during the summer were more favorable than those conducted under tent cloth, both in respect to fungi and setting fruit. Our melon crop ran into October, and there was not to be seen the slightest trace of any form of blight during the whole season. The house was ventilated freely during the day time, hence allowing insects free opportunity to fertilize the flowers, as a result of which we had a superabundance of fruit. Since it was our purpose to observe what effect the absence of moisture would have upon infection, the foliage of the vines was kept entirely free from water throughout. Notwithstanding that the various blights which affect the cucumber were present everywhere out of doors, no infection took place in this crop. We are convinced that *Plasmopara* or the downy mildew (see p. 31) can be held in check in greenhouses, if the moisture conditions are controlled; and the same may hold good to some extent in the *Alternaria* and the anthracnose. At any rate, none of these fungi made their appearance on the foliage under glass. There is considerable difference in the conditions prevailing under glass from those under tent cloth. Tent cloth may succeed in keeping off dews and mists from the plants. It will, however, allow rain to pour through without much difficulty, whereas the greenhouse can be kept practically tight. In

conclusion, it may be stated that it is not generally conceded by tobacco growers who experimented with cucumbers, etc., under tent cloth, that this method of culture will be of any practical importance in the cultivation of garden crops. It is quite evident, however, that it succeeds in producing plants of better foliage, and, on the whole, it has a value in certain cases of preventing infection.

Experiments in Heating Soils.

The rather unusual interest taken in the problem of soil sterilization within the last few years has been the means of inducing growers to improvise various devices for heating soil. Some of these appliances have been constructed for personal use only, while others have been patented and placed on the market. The diameter of the tubing and method of perforating, together with the size and number of the perforations, differ much in the various appliances. The amount and pressure of steam and distance between pipes in the soil also vary with different appliances, as does the relative efficiency and cost of heating. Our experiments, which were rather limited in extent, consisted in testing the relative heating capacity of pipes one foot long and of various diameters, which contained the same number and area of perforations; also of pipes of the same diameter, containing various sizes and numbers of perforations. We made use of iron pipe, galvanized iron and tin tubing, and porous tile. In order to test their relative efficiency, we placed them in the centre of a keg that had a hole bored in the side for a thermometer, which in each case was placed about six inches from the tubes. The keg was filled with soil, and steam entered into the tube. All of the tubes except the tile were plugged at the lower end, and the steam had to penetrate the soil through the perforations. The table shows the result of these experiments: —

Table showing the Relative Heating Efficiency of Tubes of Various Diameters, Sizes, and Numbers of Perforations.

Kind of Tube.	Number of Perforations.	Area of Perforations (Square Inches).	Size of Perforations (Inches).	Time required to heat Soil 200 Degrees F. (Minutes).
(*a*) Two-inch iron pipe, . .	44	1.21	3/16	5
(*b*) One-inch iron pipe, . .	44	1.21	3/16	11
(*c*) Two-inch colander tin, .	4,646	14.26	1/16	2½
(*d*) Two-inch galvanized iron,	29	1.42	¼	2
(*e*) Two-inch galvanized iron,	116	1.42	⅛	3¼
(*f*) Two-inch tile, . . .	–	–	–	7½

A comparison of one-inch and two-inch iron pipes, each containing four rows, giving a total of forty-four perforations, three sixteenths of an inch in diameter, gave as a heating capacity for two-inch pipe five minutes, and for one-inch pipe eleven minutes; or, in other words, it requires six minutes longer for the one-inch pipe to heat the same mass of soil than the two-inch pipe. An average of four experiments gave for the two-inch pipe nine minutes and for the one-inch pipe seventeen minutes, or nearly the same ratio.

Two tests were made with one and one-half inch pipe, similar in every way to those just described. Since this pipe was mislaid, further experiments with it were discarded. It may be stated, however, that the results obtained by the use of this pipe were better than those with the one-inch, although not so good as those obtained by the use of the two-inch.

A comparison of the three perforated tin and galvanized iron tubes (*c*, *d* and *e*) showed little variation in heating capacity. The colander tin tubes, however, had a great many perforations, representing a much larger area for steam to escape. Notwithstanding this, it was not superior to tube *d*, which was a section of Cartter's sterilizing apparatus. The experiment with tile (*f*) was, as might have been expected, less satisfactory as a heater than any of the others except the one-inch pipe. The lower end of the tile was not closed, hence practically all the heat which escaped did

so through both ends of the tile, and only a little through the pores.

In these experiments it appears that a two-inch pipe is far superior to a one-inch pipe as a heater, where the number and size of the perforations are the same; also that for all practical purposes one-fourth-inch perforations are better than smaller ones, even where the total area is the same or even greater. It is therefore not so desirable, if efficiency is to be considered, to construct sterilizers out of one-inch iron pipe, as some have done, inasmuch as a two-inch tubing with three-sixteenths or one-fourth inch perforations will give better results. The best results were obtained with a section of Cartter's tube, which contained four rows of perforations one-fourth inch in diameter.

In heating soils there are many factors which have to be taken into consideration, such as the pressure and the amount of steam supplied, the size of the apparatus, and the amount of earth that is to be heated. These factors are so variable that probably no two men have sterilized soil at the same cost. Sterilizers that will do rapid and cheap work at a certain pressure and supply of steam will do less work at a greater cost with the same pressure and less volume of steam. It is not only essential that the sterilizer should be constructed on the best principles, but the volume of steam and pressure maintained should be adapted to the requirements.

Influence of Sterilized Soil on Seed Germination.

In previous reports and bulletins from this station there have been given results of some experiments relating to the influence of various agencies upon the germination of seeds. For some years much use has been made of sterilized soils by this division in studying the various diseases of greenhouse crops. In numerous experiments, made upon a considerably large variety of plants, we have always noticed the marked effect which sterilization had upon the germination of seeds and the subsequent growth of the plant. Many photographs have been made from time to time of those crops which display very important differences, and in some instances the weight of the plants has been recorded, which

show the marked effects that soil sterilization has upon germination and growth. We had made no experiments, however, to ascertain to what extent acceleration took place in seed germination, until the following were made, the results of which are shown in the table: —

Germination of Seeds in Sterilized and Unsterilized Soil.

Number of Experiment.	Kind of Seed.	Total Number of Seed tested.	Number germinated in — Sterilized Soil.	Number germinated in — Unsterilized Soil.	Per Cent. Gain or Loss.
Experiment 2,	Radish,	600	159	81	41
Experiment 3,	Tomato,	600	93	110	—13
Experiment 5,	Cucumber,	600	281	187	33
Experiment 10,	Lettuce,	600	26	10	61
Experiment 11,	Tomato,	600	37	33	10
Experiment 13,	Onion,	400	48	31	35
Experiment 14,	Mustard,	400	84	32	61
Experiment 15,	Turnip,	400	105	37	64
Experiment 16,	Red clover,	400	68	45	33
Experiment 17,	Onion,	200	57	32	43
Experiment 18,	Red clover,	200	83	73	12
Experiment 21,	Lettuce,	200	87	26	70

In these experiments we purposely made use of seeds representing considerable variations in age and of low germinating capacity, and where certain numbers are omitted in column 1, it should be understood that in such cases the seeds were so old that little or no germination took place. The seeds in each experiment were taken from uniform lots, *i.e.*, they were supposed to be of the same age and from the same source; and where the same kind of seed appears twice in the table, it indicates that they are of different age and origin. Two hundred seeds were used in each experiment, one hundred being sown in sterilized soil and one hundred from the same lot in unsterilized soil. In some instances the experiment is repeated three times, in which case we have the average germination of six hundred seeds. The soil used was the same, except that one lot was sterilized, the other not. The lower the per cent. of germination

which seeds exhibit, the more important it is that a larger number should be employed in order to obtain true averages. Where seed showed 95 per cent. germinating capacity, a test including one hundred seeds is of some value. On the other hand, where there is only a germination equal to 10 per cent., a truer average can be obtained by employing eight hundred or a thousand or more, or, what is better, to repeat the experiment at least half a dozen times with a smaller number of seeds. The high percentages given are somewhat misleading, as the number of seeds used was not sufficient to obtain reliable averages. All of the experiments could be repeated to advantage. Since in many instances the seeds were used up, it was not possible to continue the experiments further. These experiments, nevertheless, possess a certain value, and the results coincide in a general way with what we have continually observed in the greenhouse. In germinating thousands of lettuce seeds in boxes we have noticed many instances similar to that shown on No. 21, although the percentage of gain is too high for average results. The average acceleration given in all of the experiments shown in the table, or the percentage of germination noted on the fourth day after planting, was 25 per cent. in favor of the sterilized soil. It will be noticed that the tomato seeds do not respond to sterilized soil, and in four out of seven tests those growing on unsterilized soil gave the best results. Since these experiments are preliminary ones, and are being continued, further comments at this time are not necessary, except to relate that from an economic point of view we consider it worth while to start such plants as lettuce, cucumbers, melons, tobacco, etc., in sterilized soil, provided steam is available. In such cases the expense would be very insignificant. Besides returns from acceleration and increase in germinating capacity, the important factor of immunity from diseases such as those arising from the damping fungus, etc., is important.

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

The work of the meteorological division of this station during the past year has been much the same as outlined in previous reports. The abnormal temperature conditions prevailing during much of the growing season caused more than the usual interest in the monthly bulletins issued, and in abstracts from them published by a considerable number of the papers of the State.

At the end of June, Miss S. C. Snell, the voluntary observer for the United States Weather Bureau, resigned after a service of more than twenty-five years. At the request of Mr. J. W. Smith, section director, the station has arranged to furnish the temperature and precipitation records on the voluntary observer blanks, in addition to the records published in the monthly bulletin. All records for Amherst now published in the monthly report of the New England section of the climate and service of the Weather Bureau are now credited to the Hatch Experiment Station, instead of only the barometer and wind records, as formerly. Arrangements have been made to furnish the weekly snow reports to the Boston office the present winter, as heretofore.

The local forecasts for the weather of the following day have been furnished daily, except Sunday, as in former years. Their transmission to the college by telegraph has been less satisfactory than formerly, owing to the interference of the electric currents of the local electric railways. If our telegraph line from the Western Union office to the tower could be relocated, so as to avoid this interference, the forecasts could be received more certainly and promptly.

The monthly observations of the declination of the mag-

netic needle have been made, as indicated in last year's report. The laying of steam pipe to the several buildings during the summer has probably affected the results of the last few months. Pending a more complete report of these results, it may be stated that the mean declination for 1900 was 11° 10′ west; for 1901, 11° 10′ west; and for the present year, 11° 14′ west.

The equipment has remained practically the same during the year. In the near future a number of new clocks for some of the self-recording instruments will be required.

At the close of the college year, in June, Mr. H. L. Bodfish, the observer, retired from the division, and was succeeded by the assistant observer, Mr. S. C. Bacon.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

During the year 1902 the work of the entomological division has been concentrated along a few but important lines. The correspondence has, as usual, occupied much time, and a large portion has been of a routine nature. This part of the work is of great importance, and it has been the intention to give the most careful attention to every letter received, however common the insect concerned may be, as the greatest amount of assistance is often needed in order to effectively combat the most common forms.

Extensive experiments on the best methods of treatment for the San José scale under New England conditions have been carried on in the college orchard during the year. Over six hundred trees have been treated in different ways, and the results studied by means of repeated inspections during the summer and fall. A discussion of this work and its results thus far is now being prepared for publication as a station bulletin.

Much attention has also been given to the preparation of the early stages of insects for the insectary collection. As in most cases the injuries caused by insects are while the latter are immature, the importance of representing all stages in a collection at once becomes evident. In connection with the additions thus made, an extensive rearrangement of the collection has been begun, the result of which will be to make it more instructive and available for direct study and comparison than ever before. Many records and life histories have also been added to the insectary files.

Work on the card catalogue, referred to in previous reports, has been continued, and the value of the catalogue as

a whole is demonstrated by its frequent use each day. From it a bibliographical catalogue of the scale insects of the world has been prepared, and is ready for the printer.

The nursery inspection law, passed by the Legislature of 1902, has removed the work of nursery inspections from the list of duties of the entomological division of the station; but the appointment of the associate entomologist of the station as inspector has enabled him to make the service of the station available to many who were not previously aware of the opportunities it offers for assistance in difficulties they meet, and it has also enabled him to learn more of the entomological problems which need investigation in the State than could possibly have otherwise been the case.

Insects of the Year.

No serious insect outbreaks have been observed during the year, though many kinds have made their presence felt.

The brown-tail moth has continued to spread, and in the more central portion of its distribution has become extremely abundant. So serious is it in some places that city and town authorities have taken up the work of gathering and destroying the tents during the winter months, as a partial method of relief from the sufferings which would otherwise be caused from the irritation on the human skin produced by the hairs of this insect during the following summer months. A bulletin has been prepared on this insect, and published by the State Board of Agriculture.

The gypsy moth has increased in numbers, until in some places it is nearly as abundant as it has ever been. In general, however, it has not as yet made its presence seriously felt, though a year or two more is all that will be necessary for it to fully re-establish itself throughout its original territory.

The San José scale is now present in over one hundred cities and towns, and is rapidly spreading, though fortunately the number of food plants on which it thrives so as to endanger the life of the plant appears to be small. During the fall it was found on California privet, arbor-vitæ and

spruce, — food plants not heretofore reported, though whether it can live for any length of time on these remains to be seen.

The elm-leaf beetle has attracted but little attention this year, except in the north-eastern part of the State, where it has appeared in abundance for the first time. Elsewhere it was about as plenty as usual, and was generally treated by the tree wardens and city foresters with considerable success. It has now been established that in the Connecticut valley this insect has but a partial second brood, — so small, in fact, that the injury it causes is almost infinitesimal.

The resplendent shield-bearer (*Aspidisca splendoriferella*) has been abundant, attacking the apple leaves, but appears to have caused but a small loss. The apple-leaf miner (*Tischeria malifoliella*) appeared in abundance in apple leaves in the fall of 1901, and was present in large numbers last spring. Careful studies on this insect show that in Massachusetts it is two-brooded, the adults appearing in early spring and also in July.

Two species of *Aleyrodes* have been doing a great deal of damage in some parts of this State, — one in greenhouses, the other out of doors on strawberries and other plants. These species have long been considered identical with *Aleyrodes vaporariorum* Westw., a common European insect, but the one on strawberries proves to be a new species. Both have been very carefully studied here, and the new one described and published with illustrations in the Canadian "Entomologist," under the name of *Aleyrodes packardi*. The studies on the other species will be published with illustrations as soon as completed.

The life histories of several bugs have also been worked out, and are now in the printer's hands for publication.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Assistants: E. B. HOLLAND, P. H. SMITH, J. W. KELLOGG,[1] T. M. CARPENTER.[1]
Inspector of Babcock Machines and Dairy Tester: N. J. HUNTING.
In Charge of Feeding Experiments: ABEL GILBERT.
Stenographer: MABEL SMITH.

PART I. — OUTLINE OF YEAR'S WORK.

- A. Correspondence.
- B. Extent of chemical work.
- C. Character of chemical work.
  - (*a*) Water.
  - (*b*) Dairy products and feed stuffs.
  - (*c*) Chemical investigation.
- D. Cattle feed inspection.
- E. Execution of the dairy law.

PART II. — DAIRY AND FEEDING EXPERIMENTS.

- A. Tests of pure-bred cows.
- B. Tests of fly preventives.
- C. Summer forage crops.
- D. The pentosans.
- E. Digestion experiments with sheep, 1894–1902.

[1] During the year Messrs. Kellogg and Carpenter severed their connection with this division, to accept more lucrative positions elsewhere, the former going to the Rhode Island and the latter to the Pennsylvania Experiment Station. The loss of these two efficient workers has been seriously felt, and naturally impeded the work of the division.

Part I. — Outline of Year's Work.

J. B. LINDSEY.

A. Correspondence.

The correspondence of this division was about the same in character and amount as in preceding years. Information is asked on a great variety of subjects. Some questions can be easily answered by reference to bulletins already published, while others require considerable thought and study. The total number of letters sent out during the year has been 1,950.

B. Extent of Chemical Work.

The work in the chemical laboratory has been similar to that of previous years. The large amount of routine work in connection with the examination of water, milk, cream, butter, feed stuffs and miscellaneous substances leaves little time available for strictly chemical investigation. The amount of chemical work may be better understood by noting the variety and number of substances recorded below.

There have been sent in for examination 181 samples of water, 120 of milk, 1,482 of cream, 118 of pure and process butter, 9 of oleomargarine, 130 of feed stuffs and 9 of miscellaneous substances. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 187 samples of milk and cream, 42 of butter fat and 642 of fodders and feed stuffs. There have also been collected, under the provision of the feed law, and tested, either individually or in composite, 320 samples of concentrated feed stuffs. This makes a total of 3,240 substances analyzed during the year, as

against 3,622 last year and 3,036 in the previous year. Work on pentosans, fiber, starch, sugar and fat, and on the availability of organic nitrogen, not included in the above, has been done for the Association of Official Agricultural Chemists. In addition, 13 candidates have been examined and given certificates to operate Babcock machines in creameries and milk depots, and 2,344 pieces of glassware have been tested for accuracy.

C. Character of Chemical Work.

(*a*) *Water.*

This division during the past year has endeavored to make sanitary analyses of drinking water, so far as time and means would permit. Samples were received not only from farmers, but from persons following various trades and professions. They were practically all from wells, springs and ponds, in towns not provided with a public water supply. A few were of excellent quality, many of fair quality only, others quite suspicious, while some were entirely unfit for use. A number of samples were found to contain lead, due to the use of lead pipe. Drinking water thus polluted results in serious cases of lead poisoning. All parties are *cautioned never to use lead pipe to conduct water intended for drinking or cooking purposes.*

It has been the custom, ever since the establishment of the Massachusetts Experiment Station, in 1882, to make sanitary analyses of drinking water free of cost to citizens of Massachusetts. Because of the increase of other lines of work, and the limited funds available, it has become necessary to make a small charge for each sample of water examined. Acting under instructions from the Experiment Station committee, the following regulations have been adopted: —

After Jan. 1, 1903, there will be a charge of three dollars for each sample of water tested at this station. This charge is intended to simply cover the cost of the chemist's time and the gas and chemicals employed in the examination. Heretofore, to aid in promoting the public health, sanitary analyses of drinking water have been made free of cost to citizens of Massachusetts, although the station has in no way been required by law

to do so. The increase of other important lines of work now severely taxes the limited resources of this division, and renders such a step necessary.

Those wishing to secure a sanitary analysis of water must first apply, whereupon a glass bottle securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express. The return expressage must in all cases be prepaid. Because of the smallness of the sum involved, no account will be opened. Remittance by check, P. O. money order, or money at the owner's risk, must be strictly in advance.

Application may be made and money sent to

Dr. J. B. Lindsey,
Hatch Experiment Station.

(*b*) *Dairy Products and Feed Stuffs.*

Slightly less than the usual number of samples of milk and cream were received during the past year. They were sent largely for the purpose of ascertaining their butter fat content. Some farmers wish to ascertain the quality of milk produced by their animals, while others who sell cream wish to check the work of the local creamery. Oftentimes samples are received from milk dealers whose product has been found below the legal standard; in such cases, both total solid matter and fat are determined. Printed circulars are sent to all inquiries, giving concise information concerning the quality of milk produced by different breeds, as well as full instruction relative to the best methods to be employed in determining the butter-producing capacity of dairy herds.

This division also examines milk, cream, butter and oleomargarine collected by the agent of the Dairy Bureau in western Massachusetts. The past year the work has been confined almost wholly to the examination of renovated butter. The number of feed stuffs received was somewhat in excess of those received a year ago. In some cases a physical inspection only was necessary, while in other cases both a chemical and microscopic examination are required. Numerous samples are received from wholesale dealers, who avail themselves of the station facilities to make sure that the materials they are offering are as represented. It is the intention to give such samples immediate attention, and to return the results promptly.

(c) *Chemical Investigation.*

It is the aim of this division to devote as much attention as possible to chemical investigation, in connection with the many dairy and feeding problems. The very limited time at our disposal the past year has been given: (*a*) to the examination of butter fat in connection with feeding experiments, to note the effect of various feed constituents upon its character; (*b*) to the improvement of methods for the determination of the pentosans and starch in feed stuffs; and (*c*) to the determination of the availability of organic nitrogen in fertilizing materials. An inquiry was also conducted to ascertain the effect of two different milk-condensing processes on the nitrogenous bodies of milk.

A great deal of time has also been given to chemical work in connection with the various feeding and dairy experiments. Some of the experiments, being completed, are reported in Part II., while others are still in progress.

D. Cattle Feed Inspection.

During the past year only one complete canvass of the State has been made for the purpose of collecting samples of concentrated feeds; heretofore, at least two inspections were made yearly. More work had been done, however, along this line in the past than the small amount of money available under the law would admit; hence the necessary curtailment. The results of the samples collected and examined for 1901 were published in Bulletin No. 78, of which 9,000 copies were issued. A quite thorough inspection was made in October and November, 1902, and the feeds are now undergoing a chemical and microscopic examination. It may be said that, owing to the unusually open autumn, and because of the expectation that with the advent of new corn the prices of feeds would generally reach a lower level, dealers were carrying light stocks. Little new cotton-seed meal had arrived, and the various gluten products were in light supply. West of the Connecticut River very little material, excepting wheat feeds, was found. As soon as the weather becomes colder, and especially after the new crop

of corn becomes available, the quantity and variety of feed stuffs must be greatly increased.

In general, it may be said that the better grades of concentrated feeds, such as cotton-seed meal, linseed meal, the gluten and unmixed wheat products, are practically free from adulteration. Exceptions to this statement are to be found in the frequent admixture of wheat screenings with wheat bran, and in an entire car of so-called "Fancy Canada Bran," containing a very large admixture of coffee hulls, — a worthless feeding material.

Mixed feed, a trade name for a mixture of 1,200 to 1,800 pounds of wheat bran and 200 to 800 pounds of fine middlings and "red dog," is often seriously adulterated by substituting ground corn cobs or broom-corn waste for the middlings. This falsification is not practised by reputable millers, but by unscrupulous outside parties, or possibly by small millers in remote localities. It is hardly necessary to remark that this material is sold at the same price as the genuine. A considerable variety of oat offal is always in the market, and in some cases it is guaranteed to contain a noticeably higher percentage of protein than is shown by analysis. The manufacturers' attention has been called to this misrepresentation, but they do not choose to rectify it. A large amount of so-called provender consists of mixtures of oat offal and cracked corn in place of ground oats and corn. It is believed that this deception is increasing. The larger part of the oat offal in the market is sold at prices much in advance of its value.

Among the new feeds in the market the past year may be mentioned dried distillers' grains, — the residue in the manufacture of alcohol, spirits and whiskey, from the several cereals; and nutrene dairy feed. This latter product is made in Louisiana, and consists of cheap molasses soaked up in oat clippings or similar material, with the addition of a little cotton-seed meal, hulls, etc. Its exact value is at present uncertain.

Attention was called in the last report to the need of a new feed law, and the reasons therefor made as explicit as possible. This need cannot be too strongly emphasized at

the present time. A bill has been prepared for presentation at the coming session of the Legislature, and it is hoped it will receive the cordial support of all consumers, as well as reputable manufacturers and dealers.

E. Execution of the Dairy Law.

The text of the law (chapter 202, Acts of 1901) may be found in the report of this station for 1901, page 156. The law naturally resolves itself into three sections: (1) the testing of Babcock glassware for accuracy of graduation; (2) the examination of candidates for proficiency in operating the test; (3) the inspection of Babcock machines.

Inspection of Glassware. — All glassware found to be correct is marked "Mass. Ex. St.," by means of a sand blast. During the first year it was necessary to inspect the ware in use by all creameries and milk depots employing the test; now practically all is received from supply houses that keep tested ware in stock. The total number of pieces examined the present year has been 2,344, of which 56 pieces, or 2.4 per cent., were found incorrect. A year ago 5 per cent. were found improperly graduated. Manufacturers are now very careful concerning the accuracy of their product.

In testing glassware, the following limits of error are allowed: —

	Capacity.	Single Graduation.	Limit of Error.
	Per Cent.	Per Cent.	Per Cent.
Cream bottles, Connecticut,	30-35-40	.50	.50
Cream bottles, Connecticut,	50	1.00	.50
Cream bottles, Bartlett,	25	.20	.20
Milk bottles, common,	10	.20	.20
Milk bottles, Ohlsson,	5	.10	.10
Milk bottles, Wagner,	8	.10	.10
Skim milk bottles, double quantity,	2.00	.10	.10
Skim milk bottles, Ohlsson,	.50	.05	.02
Skim milk bottles, improved Ohlsson,	.25	.01	.01
Skim milk bottles, Wagner,	.50	.05	.02
Skim milk bottles, improved Wagner,	.25	.01	.01
	Cubic Centimetre.	Cubic Centimetre.	Cubic Centimetre.
Pipettes, cream,	18.00	-	.10
Pipettes, milk,	17.60	-	.10
Acid measures,	17.50	-	.20

Examination of Candidates. — Mr. E. B. Holland has taken charge of this work. Last year 45 candidates were examined, being principally the operators in the employ of Massachusetts creameries and milk depots. The present year 13 were examined and given certificates of competency. It is believed that practically all now using the Babcock test as a basis for payment have a good understanding of the process, and are capable of doing satisfactory work.

Inspection of Babcock Machines. — The examination of Babcock machines has been in charge of Mr. N. J. Hunting, who visited each creamery or milk depot, and made a personal inspection of all machines in use. At the time of presenting the last report it was not possible to state the results of the first inspection (1901), which showed 20 machines to be in good condition, 11 to be in need of repairs and 9 to be entirely unfit for satisfactory work. A number of machines needed levelling, and several were without a steam gauge or speed indicator. The condition of a machine frequently depends upon the operator. If he is careful and painstaking in his work, the tester is likely to be found in good repair. The total cost of the first inspection was $182.42, — $4.56 each. It was impossible to exactly apportion the cost of examining each machine, so that it seemed wiser to divide the total cost of inspection by the number of machines examined, the quotient being the cost to each creamery. It became necessary, because of the number of machines out of condition or condemned, to make a second inspection, the cost of which was apportioned as equally as possible among those directly interested. A few managers considered the cost excessive, but it was not possible to do the work for less. Simply because one-half or one hour was occupied in making the actual examination, it must not be understood that the charge should be only for the time thus employed. The entire cost covers the time actually spent en route, including occasional delays, as well as travelling and hotel expense. The proper enforcement of this law has required the expenditure of a great deal of time on the part of the employees of this division

without any financial return. The extra labor has been cheerfully given, however, with a belief that it has resulted in positive good to both creameries and patrons.

The inspection for 1902 is in progress at this writing (December 10). The inspector states that he finds nearly all machines now in good working condition, the improvement over last year being quite marked.

It is evident that the creamery law has been of direct benefit to the creameries of the State. It has decidedly improved the accuracy of Babcock glassware, taught many operators to be more careful in making the test, given the majority a better understanding of the principles involved, caused many Babcock machines to be put in proper condition to do accurate work, and replaced worn and antiquated machines with those of modern construction. The total expense to each creamery and indirectly to each patron has been merely nominal.

Part II. — Dairy and Feeding Experiments.

J. B. LINDSEY.

A. Tests of Pure-bred Cows.

During the past year this division has made the following milk, butter fat and butter tests for the several cattle associations, in accordance with their prescribed rules: —

Five cows were tested for the Holstein-Friesian Association, to ascertain the amount of milk and butter fat produced during seven consecutive days.

Nine cows are now being tested for the American Guernsey Cattle Club. The amount of milk and butter fat produced in one day of each month is ascertained, and upon this is based the monthly yield.

Two cows are now undergoing a yearly milk and butter fat test for the American Jersey Cattle Club. The amount of milk and fat produced during two consecutive days of each month is ascertained, and upon this product is based the monthly yield.

The tests are all made at the farms of the several owners, by or under the supervision of a representative of this station.

The results of the following confirmed tests, made at the request of the American Jersey Cattle Club, for Mr. C. I. Hood of Lowell, Mass., are sufficiently instructive to warrant their presentation in this report: —

Confirmed Butter Tests at Hood Farm.

Milk produced (Pounds).	Per Cent. Fat in Milk.	Butter Fat produced (Pounds).	Equal to 85 Per Cent. Butter. Pounds.	Equal to 85 Per Cent. Butter. Ounces.	Butter churned. Pounds.	Butter churned. Ounces.	Fat lost in Skim Milk and Buttermilk, etc. (Pounds).	Fat available for Butter (Pounds).	Fat recovered in Butter (Pounds).
Elsie Wolcott.									
258.12	4.96	12.81	15	1	14	10	.207	12.60	12.31
Betsona Khedive La Gros.									
282.00	5.49	15.50	18	4	17	10½	.227	15.27	14.92
Figgis.									
293.44	5.48	16.08	18	15	19	½	.160	15.92	15.85
Sophie Tenth.									
278.06	4.59	12.77	15	-	15	5½	.160	12.61	12.72
Oonan Eighth.									
211.70	5.94	12.58	14	13	14	10½	.109[1]	12.47	12.10
Brown Bessie Forty-Sixth.									
210.38	5.42	11.41	13	7	13	8½	.171	11.24	11.16
Nora of Argyle.									
276.44	5.30	14.65	17	4	16	13	.216	14.43	14.25
Oonan Fourteenth.									
287.56	4.42	12.71	15	-	15	3	.308	12.40	12.41
Hood Farm Belle.									
260.31	4.66	12.13	14	-	14	2	.221	11.91	11.41
Oonan Seventh.									
289.20	4.41	12.74	15	-	14	2½	.820[2]	11.92	11.46

[1] Fat in buttermilk not included. [2] Buttermilk contained 1.4 per cent. of fat.

The first three columns show the total milk produced in seven days, the average per cent. of fat it contained, and the pounds of butter fat actually produced by each animal.

The fourth column indicates the equivalent of this butter fat in 85 per cent. butter, and the fifth column shows the amount of butter actually churned. There are no wide variations between estimated and actual butter,[1] which means that the butter was of normal composition.

The sixth column, entitled "Fat lost," etc., means the entire amount of fat contained in the skim milk and buttermilk, and in the milk used in Babcocking. The average per cent. of fat in the skim milk was .031 per cent., and in the buttermilk (excepting Oonan Seventh), .061 per cent. In only two cases did the buttermilk show .15 or more per cent. of fat.

The seventh column shows the fat available for butter, and is obtained by deducting the fat lost in the manufacturing process from the entire quantity of fat produced.

The eighth column contains the quantity of fat actually recovered in the butter, as ascertained by chemical analysis. Theoretically, the seventh and eighth columns should agree. In five out of the ten results this is practically the case; the other five show discrepancies, which must be charged to errors in manipulation. The differences in case of Hood Farm Belle and Oonan Seventh are excessive. Of the 133.38 pounds of fat produced by the ten animals, 128.59 pounds, or 96.41 per cent., were recovered in the butter, showing a loss of 3.59 per cent. in the entire manufacturing process.

The butter was made by the regular Hood farm butter maker. Samples of each lot were taken at once by the tester, and sent to the Experiment Station for analysis. In six cases two lots of butter were made from the cream produced in seven days, and in four cases the entire cream produced during the period was churned at one time. The following table gives the analysis of the butter made from the fat produced by each animal: —

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[1] There is one exception in case of Oonan Seventh, due to the loss of considerable fat in the buttermilk.

Analyses of Butter.

Constituents.	Elsie Wolcott.	Betsona.	Figgis.	Sophie Tenth.	Oonan Eighth.	Brown Bessie Forty-sixth.	Nora of Argyle.	Oonan Fourth.	Hood Farm Belle.	Oonan Seventh.
Water, . . .	11.45	11.74	14.36	13.98	15.37	13.56	12.37	13.28	16.23	14.45
	14.27	14.24	13.30		14.35	14.63		16.91		
Fat, ...	86.37	85.34	82.87	82.98	82.23	83.27	84.82	83.81	80.75	81.00
	81.80	83.40	83.96		82.55	82.00		78.98		
Salt, ...	1.38	2.01	1.98	2.28	2.00	2.49	1.91	2.24	2.76	3.39
	3.13	1.70	1.87		4.00	2.60		3.39		
Curd, . . .	.80	.91	.79	.76	.40	.68	.90	.67	.26	1.16
	.80	.66	.87		.70	.77		.72		

The extremes in the percentage of butter fat were 78.98 and 86.37 per cent., and in the percentage of water, salt and curd, 13.63 and 21.02. The average composition of the 16 samples was: water, 14.03 per cent.; fat, 82.88; salt, 2.45; and curd, .74.

The Babcock machine in the hands of the tester has shown how much butter fat the cow has actually produced, and how much has been lost in the process of manufacturing the same into butter. The chemist has demonstrated the amount of butter fat actually recovered in the form of butter, and his results in eight out of the ten cows closely agree with those obtained by the Babcock machine (total butter fat produced minus fat lost). The chemist further gives evidence that the butter produced, while it varied somewhat in composition, was of normal character.

It is clear from the above data that the amount of butter fat produced by the cow furnishes, to say the least, accurate and consequently satisfactory evidence of her butter-producing capacity.

The results, taken as a whole, reflect much credit upon the work done by the testers and butter maker.[1]

[1] These confirmed tests were made by Messrs. F. R. Church, W. A. Conant, E. S. Fulton and B. Tupper. In each case the work was very carefully done.

B. Tests of Fly Preventives.

For the past two years this division has made a trial of a number of so-called fly removers. These materials are generally sold at retail for from one to one and one-half dollars a gallon. No effort was made to ascertain the exact composition of each. They appeared to consist largely of some oil such as crude petroleum, to which more or less pine tar had been added. In one case fish oil was noticed, and in another light coal tar oil. When not too thick, they were applied with a Woodason or Aspinwall sprayer; otherwise, a four-inch varnish brush, dipped in the liquid, was very lightly drawn over the animals. The latter method is less satisfactory, for the reason that it is hardly possible to avoid putting on an excess; in which case it forms a sticky mass with the hair, to which the dust adheres, giving the animals a very untidy appearance.

Brands and Manufacturers.

Brand.	Manufacturer.	Location.
1. Sure Thing,	Empire State Shaft Coupling Company.	Utica, N. Y.
2. Cattle Comfort,	Hammond Slug Shot Works,	Fishkill, N. Y.
3. Stop Fly,	Standard Oil Company,	New York, N. Y.
4. Norwood Sanitary Fluid,	Smith, Kleine & French Company,	Philadelphia, Pa.
5. Flylene,	American Glucose Works,	Camden, N. Y.
6. Shoo Fly,	Shoo Fly Manufacturing Company,	Philadelphia, Pa.
7. Eli Fly Chaser,	Vail Seed Company,	Indianapolis, Ind.
8. Eureka,	J. H. Ames Company,	Bowdoinham, Me.
9. Rippley's Fly Remover,	Rippley Hardware Company,	Grafton, Ill.
10. Cyphers Anti-fly Pest,	Cyphers Incubator Company,	Boston, Mass.

Results with Cows.

The cows were treated in the morning before being turned out in the yard, and again at night before milking. They were observed at frequent intervals during the day, in order to note the effect of each particular brand.

1. *Sure Thing.* — Applied as spray. Keeps off flies for a short time, but not lasting in its effects.

2. *Cattle Comfort.* — Applied as spray. Not very satisfactory.

3. *Stop Fly.* — Applied as spray. Favorable effect disappeared in one-half hour.

4. *Norwood Sanitary Fluid.* — Applied as spray. This material is unquestionably crude creolin; it is very valuable as a disinfectant, but not satisfactory as a fly remover.

5. *Flylene.* — Very effective, keeping the flies off for a long time.

6. *Shoo Fly.* — Applied with brush. It was fairly effective in keeping off small flies, but not the large house fly.

7. *Eli Fly Chaser.* — Applied with brush. Same as No. 6.

8. *Eureka.* — Fairly satisfactory. Weather cool, and trial consequently not as thorough as others.

9. *Rippley's Fly Remover.* — Keeps small flies off for a short time. One year's trial.

10. *Cyphers.* — Keeps flies off for a short time. Only one year's trial.

Tests with Other Substances.

11. *Light Coal Tar Oil.* — This is the lighter of the two oils derived from tar. It was obtained through the courtesy of the Pocahontas Collieries Company, Pocahontas, Va. It appears as a dark, thin oil, with a strong creosote odor. It was applied as a spray, and gave quite satisfactory results.

12. *Recommended by J. M. W. Kitchen, M.D.* — One pound resin, one-half pound caustic potash, two pounds whale oil soap (chipped), two quarts water. Boil these until all united into a smooth liquid, then add one pound pine tar and one pint kerosene. Thin down if necessary with water and kerosene. This mixture was quite thick and heavy. It was applied lightly with a brush, but was not effective.

13. *Recommended.* — One-half tea cup bi-sulphide carbon, in which dissolve one tablespoonful pine tar, stirring thoroughly until tar is dissolved, and then add one quart kerosene or crude petroleum, and apply as a spray. This mixture was quite effective for a few hours, until the carbon bi-sulphide had evaporated. It must be kept in glass-stoppered bottles.

Results with Horses.

The agricultural division of this station gave a number of these articles a test with work horses, applying the same with an Aspinwall sprayer.

1. *Sure Thing.* — Keeps flies off well for about five hours; the large green fly does not mind it. Gums horse some.

2. *Cattle Comfort.* — Lasts about three-fourths of a day. Gums horses.

3. *Stop Fly.* — Ineffective.

4. *Norwood Sanitary Fluid.* — Ineffective.

5. *Flylene.* — Keeps flies off well, and gums horses but little. Very satisfactory.

6. *Eli Fly Chaser.* — Quite satisfactory, and equal to No. 5. Does not gum badly.

7. *Eureka.* — Same as No. 6.

8. *Cyphers.* — Protects for short time only and gums badly.

General Conclusions.

(*a*) Quite satisfactory: 1. Flylene; 2. Eureka; 3. Eli Fly Chaser; 4. Shoo Fly; 5. Light coal tar oil.

(*b*) Less satisfactory: 1. Sure Thing; 2. Cattle Comfort; 3. Rippley's Fly Remover; 4. Cyphers Anti-fly pest; 5. Recommended mixture No. 13.

(*c*) Unsatisfactory: 1. Norwood Sanitary Fluid; 2. Stop Fly; 3. Recommended mixture No. 12.

The only objection to those marked "quite satisfactory" is their cost. It is hoped that we shall be able to find some cheaper and equally effective substance or mixture. The most promising substance is the light coal tar oil. Even at the present cost of the commercial articles, it is believed their use is warranted, because cows remain much quieter, and horses work better and require less attention from the driver.

C. Summer Forage Crops.

(a) Winter Wheat and Sand or Hairy Vetch.

This mixture of a non-legume and legume has been tried for a number of years at the station, and has proved to be an early and desirable spring green fodder. The only ob-

jection is to be found in the present cost of the vetch seed, — $5 or more a bushel. This excessive cost is due to the fact that the vetch is a poor seeder, and frequently sheds its seeds before they can be harvested.

History of the Several Trials. — The first planting of this mixture, Aug. 1, 1898, winter-killed, in all probability, owing to the fact that the seed was sown too early.

The second planting, made Aug. 25, 1899, in the proportion of 2 bushels of wheat to 1½ bushels of vetch, wintered well, and made a fine spring growth. Cutting began May 31, and the yield was at the rate of 10 tons to the acre.

The third planting was made Aug. 24, 1900, with equal quantities of wheat and vetch seed. The autumn of that year was extremely dry, and the wheat killed out to some extent, so that the vetch predominated. The following spring was wet and cold, — a condition which appeared to favor the growth of the vetch at the expense of the wheat. At the time of cutting, May 30, the vetch had completely covered the wheat in spots, and had lodged badly. The vetch roots were full of the characteristic nodules. The weight of the entire yield was not obtained, but a conservative estimate places it at 6 to 7 tons to the acre.

The fourth planting (⅓ acre), made Sept. 3, 1901, at the rate of 1½ bushels of Rural New Yorker No. 6 wheat and 1 bushel of vetch to the acre, wintered well, and cutting began May 28, at which time the mixture was from 2½ to 3 feet high. At that time the wheat was about ready to show the head, and scattered vetch blossoms were noticed. When in full bloom the mixture stood from 3½ to 4 feet high. The total yield was 6,545 pounds, equivalent to 9.5 tons to the acre.

Further Use of the Land. — Immediately after the removal of this crop the land was ploughed, a light dressing of manure applied, and seeded with Longfellow corn. A yield (the past season) of 35,362 pounds (17.68 tons) of fairly well-eared green fodder to the acre was secured. The land was light and the rainfall excessive, which conditions were favorable, excepting lack of heat, for fodder production. The total product of this piece of land for one year (first sown to wheat and vetch, and followed by corn) was at the rate

of 8,622 pounds of dry matter to the acre, being equivalent to fully 5 tons of well-cured hay. It is not to be expected that such quantities could be obtained yearly under average conditions, for the land could not be as fully utilized. It is interesting to note, however, the quantity of fodder that may be secured from an acre of land in an average state of fertility, when climatic conditions are favorable and the land is occupied the entire season.

Best Method of growing Wheat and Vetch. — The land should be ploughed, harrowed if necessary, manure spread at the rate of 4 to 6 cords to the acre,[1] harrowed in; a mixture of 1½ bushels of wheat and 1 bushel of vetch sown broadcast about September 1, and covered, not too deeply with a wheel or other harrow. Cutting should begin just before the wheat heads appear, which in this locality is the last of May. The green crop will remain in feeding condition for twelve to fourteen days. If more of the fodder mixture has been produced than can be fed green, the balance may be made into hay. The vetch seed may be procured of New York seedsmen.

Composition of Wheat and Vetch.

Constituents.	Green Fodder.		Dried Fodder.	
	No. 1.	No. 2.	No. 1.	No. 2.
	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Water,	83.40	79.60	11.90	13.70
Ash,	1.50	1.76	7.97	5.22
Protein,	3.25	3.14	17.07	10.93
Fibre,	5.13	5.98	28.38	29.51
Extract matter,	6.24	8.92	32.52	38.70
Fat,	.48	.60	2.16	1.94
	100.00	100.00	100.00	100.00

The percentage of protein in the mixture is dependent to an extent upon the quantity of vetch present. In case of

[1] Fertilizer may be used in place of manure, at the rate of 50 pounds of nitrate of soda, 300 pounds of acid phosphate and 200 pounds of muriate of potash to the acre. In the spring a top-dressing of 50 to 100 pounds of nitrate of soda will prove beneficial.

sample No. 1 of both the green and dry fodder, the vetch predominated. In case of sample No. 2 of the dry fodder, the wheat was probably in excess. In fodder combinations it is difficult to secure an even distribution of the several plants. The mixture of 1½ bushels of wheat and 1 bushel of vetch per acre is satisfactory, does not lodge, and will show from 12 to 15 per cent. of protein in a thoroughly air-dry condition.

Digestibility of Winter Wheat and Sand Vetch. — Five digestion trials have been made with two different samples of green fodder, and six trials with two samples of the dried material: —

Series.	Fodders.	Number of Trials.	Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Extract Matter (Per Cent.).	Fat (Per Cent.).
VI.	Wheat and vetch (green),	3	67.54	42.47	76.27	66.05	71.13	55.65
VII.	Wheat and vetch (green),	2	70.13	43.59	70.92	70.50	75.05	57.92
	Average,	5	68.58	42.92	74.13	67.83	72.70	56.56
VII.	Wheat and vetch (dry), same as Series VI. (green).	3	68.33	59.41	76.86	64.47	69.71	63.46
VII.	Wheat and vetch (dry),	3	64.50	35.20	70.77	64.59	66.75	63.75
	Average,	6	66.42	47.31	73.82	64.53	68.23	63.61
	Dent fodder corn (milk), for comparison.	9	70.00	-	61.00	64.00	76.00	78.00
	Oats and peas (bloom), for comparison.	5	70.00	49.00	74.00	61.00	72.00	64.00

The several digestion trials make it clear that the wheat and vetch mixture is as digestible as either fodder corn or oat and pea fodder. They also show this fodder when dried under normal conditions to be as digestible as when fed green.

General Conclusions.

1. Wheat and sand vetch is a hardy fodder mixture.

2. When sown the previous autumn, it will be ready to cut the last of May, and is considered preferable to rye.

3. It will yield about 10 tons of green material to the acre under average conditions, and in composition, digestibility and feeding value it fully equals peas and oats and similar crops.

4. Because of the present cost of vetch seed, it is doubtful if the ordinary dairyman can afford to grow it; but the milk producer in the vicinity of profitable markets, who cultivates intensively, may find it a satisfactory source of early green feed.

5. Wheat seeded by itself in early September makes a fairly satisfactory early soiling crop, and is to be preferred to rye.

6. The dried wheat and vetch fodder if cut when in bloom is preferable to ordinary hay for milk, but, on account of the increased cost of production, it would hardly be considered profitable as a hay substitute.

(*b*) *Corn and Soy Beans.*

Attention has already been called (in Bulletin No. 72) to the value of this fodder combination for August and September soiling. The present season about one-third of an acre was grown. In early September the beans were podding and the corn was fairly well eared, but the ears were only partially developed. The mixture was cut and bound successfully October 4, with the Deering corn harvester, at which time the bean stalks were quite tough, the bean pods filled and the corn kernels glazed. This is the first attempt made to cut the corn and bean mixture with a harvester. A larger area will be planted another season, in order to see if the mixture can be economically handled for silage.

Corn and soy bean silage was grown and used at this station during 1895 and 1896. At that time the corn and beans were grown in separate fields. The silo was filled in the proportion of two-thirds corn and one-third beans. The silage was satisfactory, eaten clean, and furnished 30 per cent. more protein than did corn silage. It was believed at the time, however, that the increased cost of handling the two crops when grown separately more than counterbalanced the value of the additional protein secured. If it proves economical to grow and handle the two together, it will in a measure aid in increasing the supply of home-grown protein.

(c) *Soy Beans v. Cow Peas.*

Much is being said in the agricultural press concerning the home production of protein, and this division receives frequent inquiries concerning the relative merits of soy beans and cow peas for this purpose.[1]

During the past season the following varieties of cow peas were tested: Whippoorwill, Black, Extra Early Black and Warren. Although seeded the first of June, they grew but little until late in July, the unusually cool season being decidedly unfavorable to their development. The Whippoorwill and Black produced a few blossoms early in September. The former yielded about 5 and the latter 7 tons of green fodder to the acre. The seed of the Whippoorwill did not come up as well as did the Black.

The Extra Early Black seeded fully in September, but the growth was not sufficient to warrant its use for green feed.

The Warren blossomed some, but did not grow to sufficient size to be suitable for forage purposes.

The Whippoorwill and the Black are probably the best suited to northern conditions.

In comparing the relative merits of the two legumes, it may be said that the stem of the cow pea is softer than that of the soy bean, and that the crop does its best in very warm weather, and is likely to succeed better than the soy bean upon light, sandy soils, naturally deficient in moisture.

The medium green soy bean, on the other hand, prefers a medium moist loam, and will yield more dry food material, and especially more seed to the acre at moderate temperatures, than the cow pea. The cow pea is better suited to southern, and the soy bean to northern conditions, and the latter is regarded as decidedly preferable in New England.

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[1] This division is giving what is termed the "protein problem" considerable attention. While the growing of soy beans, cow peas and clover will in many cases prove economical, it is believed that the majority of Massachusetts dairymen will be obliged to purchase at least a portion of their protein in the form of cotton-seed meal, gluten or other nitrogenous meals, and depend upon the farm for the production of the carbohydrates in the form of hay and corn.

D. The Pentosans.

J. B. LINDSEY.

(*a*) *Character of Plant Tissue.*

Various investigations have shown that the larger part of the cellular structure of vegetables and coarse fodders consists:[1] (1) of substances insoluble in water, but soluble in dilute mineral acids, and which are classified as hemi-celluloses; (2) of substances insoluble to any extent in dilute mineral acids, alkali, or F. Schulze's reagent, and which are turned blue by sulphuric acid and iodine, namely, the true celluloses; (3) of lignin acids, which compose one-third to one-half of the true woods, but exist only in small quantities, if at all, in the soft new cells of young plants and vegetables.

Under the hemi-celluloses[2] belong the mother substances dextran, lævulan, mannan, galactan and pentosans (araban and xylan), which on inversion yield dextrose, lævulose, mannose, glactose, arabinose and xylose. These hemi-celluloses are intermixed and perhaps chemically united to the true celluloses and ligno-celluloses in the cell walls of plants and seeds. In some cases they have been recognized as reserve material, and are used as food in the sprouting of the seed.

The true celluloses, upon being dissolved in strong sulphuric acid, and the resulting product hydrolyzed with dilute acid, yield dextrose as a rule, hence the name dextroso cellulose. Schulze has also recognized mannose and xylose, consequently there exist dextroso, mannoso and pentoso celluloses.

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[1] This classification does not include amyloid, a substance soluble in water, and yielding various sugars by hydrolysis. See Winterstein, Zeitsch. f. physiol. Chem., 15, 1892; also Agricultural Science, 1893, p. 162.

[2] See various publications of E. Schulze in Zeitsch. f. physiol. Chem.

The lignin acids are probably strongly united to the dextroso cellulose, and it seems reasonable to suppose also to the pentoso cellulose.

(*b*) *Recognition of the Pentosans.*

By treating wood with dilute alkali, and precipitating the extracted material with alcohol and hydrochloric acid, Th. Thomson[1] obtained a substance termed wood gum (Holzgummi): and by inversion Koch[2] secured wood sugar or xylose, which was carefully examined by Wheeler,[3] Allen[4] and Tollens, and declared to be a pentose ($C^5H^{10}O^5$). The mother substances in wood gum and also in cherry gum[5] contain less water than the pentoses, and are termed pentosans ($C^5H^8O^4$). The substance yielding xylose was termed xylan, and that yielding arabinose, araban.

(*c*) *Methods for Determination of Pentosans.*

After wood gum and the resulting sugar had been carefully studied, it became necessary to obtain a method for their quantitative determination, in order to note to what extent they occurred, especially in agricultural products. The first experiments were made by Stone, Wheeler, Allen and Tollens,[6] by dissolving the substance in hydrochloric acid, precipitating the furfural with ammonia, and weighing the resulting furfuramid.

Gunther[7] and Tollens distilled with hydrochloric acid of 1.06 specific gravity, and titrated the distillate with acetate of phenylhydrazine, using analine acetate as indicator.

Stone[8] proposed a method in which he titrated the distilled furfural with a dilute solution of phenylhydrazine of known strength, using Fehling solution as indicator.

De Chalmot[9] and Tollens precipitated the furfural distillate

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[1] Journal for Pract. Chem., 19, (2) p. 146.

[2] Pharm. Zeitsch. für Russland, 25, p. 619, 635, 651.

[3] Liebig's Ann. Chem., 254, p. 304.

[4] Liebig's Ann. Chem., 260, pp. 289–306.

[5] From cherry gum, Scheibler first obtained the arabinose ($C^5H^{10}O^5$).

[6] Loco citato.

[7] Berichte, 23, p. 1751; 24, p. 3575.

[8] Journal of Analyt. and Applied Chem., Vol. V, No. 8, p. 421.

[9] Berichte, 24, p. 3579.

with acetate of phenylhydrazine, dried and weighed the precipitate in glass tubes. This method was further studied and improved by Flint,[1] Mann[2] and Tollens, and was designated the phenylhydrazine method. The Association of Official Agricultural Chemists adopted this method at its meeting in 1895, and later it was slightly modified by Krug.[3]

Hotter[4] recommended that, in place of phenylhydrazine, a portion of the furfural distillate be heated in closed glass tubes with pyrogallol, and that from the weight of the resulting precipitate be calculated the percentage of furfural.

Counciler[5] suggested that phloroglucol be employed instead of the pyrogallol, for the reason that the union of the furfural with the phloroglucol would take place at ordinary temperature. Krüger,[6] Rimbach[7] and Tollens studied and perfected the method, and recommended it as reliable for the determination of pentosans in coarse fodders, grains and vegetables. The Association of Official Agricultural Chemists adopted the phloroglucol method as recommended by Krüger and Tollens in 1897, as a provisional method with slight modifications, the most important of which was the use of the Gooch crucible in place of filter paper for collecting the precipitate. Kröber[8] and Tollens have recently published the results of a very exhaustive investigation of the phloroglucol method, together with a complete table for converting any weight of phloroglucid between .030 and .300 gram into furfural, arabinose, araban, xylose, xylan, pentose and pentosans. The principal conclusions were as follows: —

1. That the results are not influenced by the length of time (over fifteen hours) the precipitate stands.

2. That the phloroglucid is best collected in a Gooch crucible.

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[1] Berichte, 25, p. 2912; Landw. Vers. Stat., 42, p. 381.
[2] Zeitsch. f. Angw. Chem. 1896, p. 33, 194.
[3] Bulletin 49, Division of Chemistry, U. S. Department of Agriculture.
[4] Chemiker Zeitung, 1893, p. 1743.
[5] Chemiker Zeitung, 1894, No. 51.
[6] Zeitsch. für Angw. Chem., 1896, Heft 2.
[7] Inaug. Diss. Göttingen, 1898.
[8] Journal f. Landw., 1900, p. 357; 1901, p. 7.

3. That the precipitate should be washed with small quantities of water, and should not be allowed to become dry during the washing.

4. That the presence of diresorcol in the phloroglucol does not affect the results.[1]

5. That the precipitate be dried four hours in a water bath, and that the Gooch crucible be kept in a glass bottle during the drying, and be weighed in the glass-stoppered bottle after cooling, in order to prevent the hydroscopic phloroglucol from taking on water.

The Association of Official Chemists at its 1902 meeting adopted Kröber's formulæ and tables for calculating the results.

While the phloroglucol method has been perfected, it can still be regarded only as a conventional method. Furthermore, the fact must not be overlooked that other substances besides pentosans yield furfural. Thus Tollens[2] and his earlier pupils have shown that glycuronic, euxanthic and urochloralic acids yield furfural on distillation with hydrochloric acid, and Cross and Bevan[3] have obtained furfural from oxycellulose. Widstoe[4] and others[5] have also shown that methyl pentosans $C^5H^7(CH)^3O^4$ frequently accompany the true pentosans, and upon distillation yield methyl furfural $C^5H^3(CH)^3O^2 + 2H^2O$ and is likewise precipitated by phloroglucol. Fraps[6] finds that the hydrochloric acid distillate from hay yields on standing, besides furfural, a black precipitate and other substances which are precipitated by phloroglucol. These latter he termed furaloids.

Cross and Bevan[7] have applied the term furfuroids in place of pentosans to all furfural-yielding substances. Tollens, on the other hand, as well as Stone,[8] believe it preferable to retain the old name.

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[1] This statement has been disputed by American chemists (see especially Fraps, Bulletin No. 172, North Carolina Experiment Station).

[2] Loco citato.

[3] Berichte, 27, p. 1061.

[4] Berichte, 33, p. 143.

[5] Zeitsch. für Angw. Chem., 1902, Heft 20, p. 481.

[6] Am. Chem. Jour., 25, p. 501.

[7] Chemical News, 1894; Am. Chem. Jour., 22, p. 634.

[8] Chemical News, 1895, p. 40.

(*d*) *Perfected Methods*[1] *for the Determination of the Pentosans. — Present Phloroglucol Method.*

Reagents.

Twelve per cent. hydrochloric acid (specific gravity 1.06): 275 c.c. conc. acid (specific gravity 1.20) to 725 c.c. water; test with a hydrometer as 15° C.

Phloroglucol solution (purified): 11 grams are dissolved in 300 c.c. hot 12 per cent. acid by constant stirring, made up to 1,500 c.c. with cold acid, allowed to stand several days for the diresorcinol to crystallize out, and filtered immediately before use.

Pumice stone: the stone is prepared by dropping it at white heat into distilled water, and leaving it there until required.

Aniline acetate (test solution): equal parts of aniline and 50 per cent. acetic acid.

Apparatus.

Erlenmeyer flask, 300 c.c.; Liebig condenser and Aubrey connecting tube; separatory funnel (open); graduated cylinders; beaker, 25 ounce; Gooch crucible.

Method.

A weight[2] of material[3] that will not yield over .300 gram of phloroglucid is brought into a 10-ounce Erlenmeyer flask, together with 100 c.c. of 12 per cent. hydrochloric acid and several pieces of pumice stone. The flask, placed on a wire gauze, is connected with a Liebig condenser, and heat applied, gently at first, and regulated so as to distil over 30 c.c. into a graduated cylinder in ten minutes. The 30 c.c.

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[1] The phenylhydrazine method will be found described in the twelfth report of the Massachusetts State Experiment Station, p. 177, and in Bulletin No. 51, Division of Chemistry, U. S. Department of Agriculture. The phloroglucol method, as used in this laboratory for a number of years, is described in Bulletin No. 51, just referred to, and in the ninth report of the Hatch Experiment Station, p. 97.

[2] With material containing pentosans: 30 per cent., take 1 gram of material; 25 per cent., take 1.25 grams of material; 20 per cent., take 1.50 grams of material; 15 per cent., take 2 grams of material; 10 per cent., take 3.25 grams of material; 5 per cent., take 5 grams of material.

[3] Previous extraction with ether is not warranted, except with materials of a high fat content.

driven over are replaced by a like quantity of dilute acid by means of an "open-top" separatory funnel, the flask agitated to wash down the particles adhering to the sides, and the process continued until the distillate amounts to 360 c.c.[1]

The completed distillate is filtered to remove insoluble fats into a 25-ounce lipped beaker, graduated at 500 c.c., and 50 c.c. of phloroglucol solution gradually added, precipitating the furfural as phloroglucid, and the mixture thoroughly stirred. The solution is made up to 500[2] c.c. with 12 per cent. acid, and allowed to stand at least fifteen hours.

The amorphous black precipitate is filtered under pressure into a tared Gooch through an asbestos felt, washed carefully, never allowing it to become dry, with 150 c.c. of water, dried at 100° C. to a constant figure, weighed in a glass-stoppered bottle, and the increase reckoned as phloroglucid, from which furfural, pentosans, etc., can be calculated by the following formulæ: —

1. Less than .300 Gram Phloroglucid.

1. Furfural = (weight of the phloroglucid + .0052) × .5170
2. Pentosans = (weight of the phloroglucid + .0052) × .8935
3. Pentose = (weight of the phloroglucid + .0052) × 1.0156

2. More than .300 Gram Phloroglucid.

1. Furfural = (weight of the phloroglucid + .0052) × .5180
2. Pentosans = (weight of the phloroglucid + .0052) × .8822
3. Pentose = (weight of the phloroglucid + .0052) × 1.0025

Kröber has published very complete tables for calculating the results, which will soon be reproduced by the Association of Official Agricultural Chemists.

(*e*) *Digestibility of the Pentosans.*

The investigations of Günther, De Chalmot, Flint, Mann, Krüger, Glaubitz, Kröber and Tollens, Cross and Bevan,[3]

[1] Theoretically, the process should be continued as long as the distillate gives a reaction with aniline acetate on filter paper, but 12 distillates are usually considered sufficient.

[2] Tollens advises 400 c.c., but in this laboratory 500 c.c are preferred.

[3] Loco citato.

Winterstein,[1] Stift,[2] Stone,[3] Lindsey and Holland,[4] Wittmann[5] and others, have shown the pentosans to be very widely distributed in plants and seeds, and this general distribution naturally leads to an inquiry as to their nutritive value in the animal economy. Several investigations have been published relative to the ability of both men and animals to assimilate the sugars, xylose and arabinose. Ebsten[6] fed 25 grams of these sugars to men, and found this amount in the urine in a short time. Cremer,[7] on the other hand, found only 10 grams of arabinose in the urine after feeding 25 grams to a healthy man. Salskowski[8] concluded that rabbits were able to assimilate a portion of this sugar, and that as a result the per cent. of glycogen in the body is materially increased. Frentzel's[9] investigations indicated that glycogen could not be formed from xylose in the animal organism, that the xylose prevented the destruction of substances that naturally produced glycogen, thus causing an increase in the amount of this animal sugar in the body. Salskowski[10] found that a rabbit and hen excreted only a fifth of the arabinose fed.

Cross, Bevan and Remington[11] digested brewers' grains with 1 per cent. sulphuric acid in an autoclave at 130° C., neutralized, with carbonate of lime, filtered, evaporated the solution, and obtained 39.5 per cent. of furfural in the dry matter. The evaporated product, when mixed with gelatine and bread and fed with vegetables to rabbits, proved to be 94.5 to 98.4 per cent. digestible, no furfural or pentoses being recognized in the urine. The investigators claim that,

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[1] Zürcher Diss., 1892, p. 31.

[2] Osterr. Unger. Zeitsch. für Züchecrindustrie, 1894, p. 925.

[3] Agricultural Science, 5, p. 6.

[4] Twelfth Report of Massachusetts Experiment Station, 1894, p. 175; Agricultural Science, 8, p. 162; Proceedings of the sixteenth meeting of the Society for the Promotion of Agricultural Science, 1895.

[5] Zeitsch. Landw. Versuchst. Osterr., 4, pp. 131-139. Abs. Exp. Sta. Rec., 13, p. 420.

[6] Centralblatt f. die medicin. Wissenschaften, 1892, p. 577.

[7] Zeitsch. f. Biologie, 24, p. 484.

[8] Centralblatt f. die medicin. Wissenschaften, 1893, p. 193.

[9] Archw. f. d. ges. Physiologie, 56, p. 273.

[10] Zeitsch. Physio. Chem., 1895, p. 491.

[11] Journal of the Am. Chem., Sec. 22, p. 633.

when fully hydrolized, these substances are as digestible as starch and its hydrolized product; and in this respect they differ from the pentoses and their anhydrides. J. König and F. Reinhardt[1] report experiments with a man in which canned peas, dried peas and other foods rich in pentosans were added to a mixed diet. The results indicated that the pentosans were very thoroughly digested and assimilated.

A number of experiments have been made with farm animals, to study the digestibility of the pentosans. In 1892, Stone[2] fed corn meal and wheat bran to rabbits, and found that about 60 per cent. of the pentosans did not reappear in the fæces. A like conclusion was drawn a year later by Stone and Jones[3] from hay and different grasses fed to sheep. Lindsey and Holland[4] fed hay and different grains to sheep, and found from 55 to 90 per cent. of the pentosans digested, traces only being recognized in the urine. Weiske and Wicke reported similar results.[5] Sherman[6] found the pentosans in wheat bran to be 66.2 per cent. digested. Fraps[7] determined the digestibility of pentosans in a number of cattle feeds. The pentosans in the crude fibre he termed pseudo-pentosans, which proved less digestible than what he termed the true pentosans, as found in the nitrogen-free extract.

In addition to the experiments already reported,[8] the writer[9] has made a number of others with different varieties of hays and grains.

The table which follows contains the percentage and digestion coefficient of the pentosans, and, for the sake of comparison, the percentages and digestion coefficients of each of the other groups of substances in the several feed stuffs.

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[1] Zeitsch. Untersuch. Nahr. u. Genussmtl., 1902, No. 3, pp. 111–116.

[2] Am. Chem. Journal, 14, p. 9.

[3] Agricultural Science, 5, p. 6.

[4] Twelfth report of Massachusetts State Experiment Station, p. 175; report of the Society for Promotion of Agricultural Science, 1895, p. 54.

[5] Zeitsch. f. physiol. Chem., 20, p. 489.

[6] Journal of the Am. Chem., Sec. 19, p. 308.

[7] North Carolina Experiment Station, Bulletin No. 172.

[8] Loco citato.

[9] Together with E. B. Holland.

It includes all experiments made at this station to determine the digestibility of the pentosans.

Description of Feed Stuffs.

English Hay. — Largely Kentucky blue-grass, with a sprinkling of timothy, red-top, meadow fescue and sweet vernal grass, together with some clover.

Millet Hay. — *Panicum crus-galli.* The cultivated species of barnyard grass from Japan, now known as barnyard millet.

Black Grass. — *Juncus Gerardi.*

Fox Grass. — *Spartina patens.*

Branch Grass. — *Distichlis spicata.*

Cove Mixture. — A mixture of black grass and red-top.

Salt Mixture. — A mixture of fox grass and branch grass.

Flat Sage. — *Spartina stricta maritima* var. A variety of creek sedge or thatch. It rarely blossoms, and is easily recognized by its pale-green color.

Buffalo Gluten Feed. — The residue in the manufacture of starch from corn. It contains the gluten, bran and some broken germs. This is an old-process meal. In the new process the oil is largely removed.

New and Old Process Linseed Meals. — Crushed flax seed, after the oil has been expressed. The former is treated by the naphtha process, and the latter by warm pressure.

Atlas Meal. — The dried residue in the process of manufacturing alcohol, spirits and whiskey from the several cereals.

Peanut Feed. — Ground peanut husks.

Composition and Digestibility of Feed Stuffs, with Especial Reference to the Pentosans (Per Cent.).

Series.	Feed Stuff.	Composition (Dry Matter).						Digestibility.					
		Ash.	Protein.	Fibre.	Extract Matter.	Fat.	Pentosans.	Ash.	Protein.	Fibre.	Extract Matter.	Fat.	Pentosans.
00,	English hay (a),	6.58	11.10	30.33	48.51	3.48	19.80[1]	-	63.49	64.46	63.32	51.43	63.25
0,	English hay (a),	7.09	11.17	32.09	46.42	3.23	20.84[1]	-	59.77	63.69	60.60	51.49	64.79
III.,	English hay (a),	5.53	9.49	32.23	49.53	3.22	22.15	-	58.48	58.64	60.73	50.78	-
00,	English hay (b),	7.83	10.79	32.74	45.56	3.08	21.87[1]	-	57.32	57.14	57.85	46.90	62.54
IV.,	English hay (b),	6.34	10.04	32.67	48.53	2.42	22.25	46.25	61.22	64.96	63.17	49.51	63.95
0,	English hay (d),	7.63	9.74	32.96	47.26	2.41	20.76[1]	-	58.10	57.29	56.69	46.82	57.36
I.,	Meadow or swale hay,	6.20	7.97	31.06	52.90	1.87	18.25	-	33.88	32.97	46.03	43.60	28.62
IV.,	Barnyard millet hay,	10.18	10.73	34.48	43.05	1.56	23.35	63.15	63.67	61.59	51.58	46.34	60.66
III.,	Black grass,	7.87	8.71	28.71	52.23	2.48	24.95	68.97	54.29	57.35	49.04	45.71	47.69
I.,	Black grass,	11.67	9.51	26.80	49.54	2.48	25.22	-	62.88	60.50	56.34	41.45	63.13
I.,	Fox grass,	8.14	7.48	26.41	55.46	2.51	25.75	-	62.70	50.37	53.26	46.64	45.40
I.,	Fox grass,	5.84	7.13	26.57	57.89	2.57	28.20	-	57.00	51.30	52.00	23.80	48.96
III.,	Fox grass,	7.51	8.76	26.96	54.31	2.46	26.37	58.24	59.30	57.40	53.12	36.39	50.31
I.,	Branch grass,	10.29	8.27	26.47	52.76	2.21	26.42	-	62.26	52.25	53.78	31.48	53.50
III.,	Branch grass,	7.85	7.87	26.46	55.00	2.82	26.15	58.13	51.69	56.41	45.74	36.65	44.81
III.,	Cove mixture,	7.19	8.82	27.57	54.32	2.10	22.24	57.50	47.92	59.68	53.19	40.33	53.18
III.,	Salt mixture,	9.98	6.48	26.77	54.26	2.51	24.09	68.77	41.72	57.51	52.28	27.90	48.52

IV.,	Flat sage, ...	9.79	7.82	29.71	49.77	2.91	23.82	61.96	51.77	60.42	55.05	36.14	58.05
00,	Buffalo gluten feed, ...	.78	26.35	8.38	50.20	14.29	16.64[1]	-	84.95	43.10	81.40	81.41	79.32
0,	Buffalo gluten feed, ...	.40	22.93	8.46	54.89	13.32	17.22[1]	-	87.13	88.94	86.92	93.17	85.08
00,	New-process linseed meal, ...	5.84	40.40	8.59	41.56	4.01	13.21[1]	-	87.24	61.23	85.51	91.01	88.34
00,	Old-process linseed meal, ...	6.97	36.75	8.21	39.80	8.27	13.24[1]	-	88.79	57.02	77.55	88.59	83.99
00,	Corn cobs, ...	1.92	3.86	27.17	65.77	1.28	30.35[1]	-	17.38	65.33	60.04	50.11	63.12
00,	Dried brewers' grains, ...	3.59	22.99	14.52	51.09	7.81	23.77[1]	-	79.26	52.57	57.83	91.11	56.48
00,	Spring wheat bran, ...	6.13	17.60	11.48	59.39	5.40	28.22[1]	-	79.63	23.59	70.38	75.60	62.41
00,	Winter wheat bran, ...	6.24	17.04	9.32	62.83	4.57	23.95[1]	-	78.54	56.28	70.43	60.54	64.24
0,	Atlas meal, ...	1.03	42.63	9.73	30.84	15.77	12.76[1]	-	72.80	105.70	84.45	91.24	90.03
0,	Peanut feed, ...	5.06	12.06	54.40	22.94	5.54	20.69[1]	-	70.56	11.68	49.05	89.68	40.51
0,	Soy bean meal, ...	6.20	38.47	4.50	31.94	18.89	5.18[1]	-	90.05	50.42	72.17	85.02	64.43

[1] These results were obtained by the phenylhydrazine method; the others, by the Krüger and Tollens phloroglucol method.

The results show that the pentosans comprise from one-tenth to nearly one-third of the entire feed stuff, the grains and by-products naturally containing the smaller and the coarse feeds the larger amounts.

The pentosans are found to be fully as digestible as the other fodder groups in case of upland hays and most by-products, but rather less digestible in swale hay, salt grasses and wheat bran. An explanation of this is to be found in the fact that association affects the digestibility of the pentosans. Late-cut hays, straws and bran contain considerable lignified matter, and it is this lignified or incrusting substance which exerts a negative influence upon the digestibility of all of the several fodder groups, the pentosans proving no exception. Most grains contain relatively small amounts of lignin and pentosans. Concentrated by-products, the residues of the several grains from which the starch, fat or both have been removed, contain higher pentosans percentages than the grains, for the reason that the pentosans are found largely in the external coverings, which are always more or less lignified. The pentosans, being closely associated with the lignified tissue, are in such cases less digestible than the protein, fat or total extract matter. In other cases (gluten feed), the incrusting substances being less developed, the pentosans have a digestibility nearly equal to the other groups.

Lehmann,[1] and later Kellner and Köhler,[2] have clearly shown that lignin interferes with the digestibility of the pentosans. The former subjected oat and wheat straws to the action of dilute sodium hydrate, under low pressure, for several hours, neutralizing with hydrochloric acid. After this treatment the pentosans in oat straw showed an increased digestibility of 69 per cent. and those in wheat straws of 115. Kellner, by a similar process, found the fibre and pentosans in extracted rye straw to be respectively 84.5 and 84.8 per cent. digested.

The experiments herein reported show that sheep were able to digest from 40 to 90 per cent. of the pentosans in grains and by-products. It has been held, however, that,

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[1] Landw. Jahrbücher 24. Jahrg., 1895; I Erganzungsband, p. 118.
[2] Landw. Versuchsstationen 53, p. 278.

although these quantities are removed from the digestive tract, it is by no means certain that they have a food value equal to starch and similar substances. Considerable quantities have been recognized in the urine of human beings. Weiske and Wicke,[1] as well as ourselves, have recognized only traces in the urine of sheep. It has been assumed that they may be destroyed in the digestive tract by various micro-organisms. Tollens[2] very pertinently suggested that they were no less susceptible to such destructive influences than is starch.

It remained, however, for Kellner,[3] as a result of very exhaustive experiments with the aid of the respiration calorimeter, to furnish definite information. Oxen were fed a basal ration, to which were added at different times 2.5 kilograms of starch and 3 kilograms of rye straw, the latter previously extracted with dilute sodium hydrate under pressure. He found 2.32 per cent. of the carbon from the digested starch to be in the form of marsh gas (equivalent to a loss of 10.1 per cent. potential energy) ; and, from the extracted straw[4] digested, 3.34 per cent. of the carbon to be in the form of marsh gas (equal to a loss of 14 per cent. of potential energy). The differences were not marked. In general, the poorer the mechanical condition of the feed and the larger the amount of incrusting substance present, the longer it remains in the intestines and the greater the opportunity for micro-organisms to attack it ; and, *vice versa*, the more easily digested starchy matters, free from lignin, are more quickly resorbed and are less likely to undergo bacterial destruction. Kellner concluded that the furfural-yielding substances (pentosans) of the extracted straw took part in the formation of fat, and indirectly in the formation of flesh, to as great an extent as did either starch or cellulose.[5]

It may be safely concluded, therefore, that the pentosans are as digestible as any of the other fodder groups (except in the presence of excessive incrusting substance), and that the digested material is practically utilized in the animal organism to the same degree as the other carbohydrates.

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[1] Loco citato. [2] Journal f. Landw., 1897, p. 110. [3] Loco citato, pp. 426–428.

[4] This treated straw contained 82 per cent. of crude fibre, and over 30 per cent. of pentosans. [5] Loco citato, p. 457.

E. Digestion Experiments with Sheep.

J. B. LINDSEY.[1]

Digestion experiments were begun with sheep at this station in 1893. Two series were published in full in the eleventh and twelfth reports of the Massachusetts State Experiment Station, together with a description of the method employed (see eleventh report). Since 1894 the coefficients only of several series have been published in different reports of the Hatch Experiment Station. In the table which follows will be found the results of 185 single trials with 73 feed stuffs, being the entire number of experiments made between 1894 and 1902, excepting a few which gave results of uncertain value, and hence were discarded. The complete data for each experiment is on file at this station.

It is believed that the brief description of the various feeds found in the table will suffice in most instances to give a clear understanding as to their character. The following additional information may prove of value: —

Mixed grasses in the table includes Kentucky blue-grass, red-top, timothy, meadow fescue, sweet vernal grass, and alsike and red clover. Kentucky blue-grass and clover predominated.

English hay is a term commonly used in many localities for good upland hay, as distinct from salt and swale hays.

Gluten meal consists of the glutinous part of the corn, mixed with the starchy portion, that cannot be recovered by mechanical methods.

[1] These experiments were made with the co-operation of a number of assistants. The results in the following table were compiled from the completed data by P. H. Smith.

Gluten feed includes the glutinous part of the corn (gluten meal), together with the corn bran and broken germs.

Germ oil meal consists of the ground corn germs, from which the oil has been partially pressed.

Distillers' grains are the dried residues in the process of manufacturing alcohol, spirits and whiskey from the several cereals.

H-O feeds consist of oat offals and light oats as a basis, together with some corn, and fortified with wheat bran and cotton-seed or gluten meal.

Quaker dairy feed — formerly Quaker oat feed — consists principally of oat offal, fortified with some material rich in protein.

Data of Digestion Experiments with Sheep, 1894–1902.

[The teachings from these experiments are presented from time to time in popular bulletins treating of feeds and feeding.—J. B. L.]

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
I.,	English hay, "D," mixed grasses in bloom (taken from twelfth annual report, State Experiment Station).	-	7.63	9.74	32.97	47.25	2.41	-	55.00	-	58.00	57.00	57.00	47.00
II.,	English hay, "A," mostly *poa pratensis* in bloom, 900 gm.	7.15	5.83	7.47	36.41	47.90	2.39	1	54.90	-	53.52	56.34	55.73	41.54
								2	55.68	-	47.02	59.68	56.26	38.67
								3	57.83	-	56.25	59.60	58.85	44.42
								4	58.19	-	54.77	60.72	58.73	46.12
								Av.,	56.65	-	52.89	59.09	57.39	42.69
II.,	English hay, "B," mostly *poa pratensis* in bloom, 850 gm.	8.22	5.94	11.07	32.00	47.92	3.07	2	62.37	-	62.17	64.28	62.72	56.18
								4	65.30	-	62.86	69.76	65.38	51.27
								Av.,	63.84	-	62.52	67.02	64.05	53.72
III.,	English hay, "A," mostly *poa pratensis* in bloom, 900 gm.,	7.41	5.53	9.49	32.23	49.53	3.22	1	60.33	45.63	56.33	63.09	61.31	54.79
								2	58.43	49.45	59.78	57.11	60.52	50.57
								3	56.36	44.73	52.58	56.26	59.21	44.44
								4	59.26	46.34	57.18	60.17	60.95	50.99
								Av.,	58.60	46.54	56.47	59.16	60.50	50.20

III.,	English hay, "B," the same as III., "A," . . .	-	-	-	-	-	-	1	59.60	52.19	57.53	60.68	60 20	53.85
								5	63.18	48.45	62.47	65.90	63.54	57.63
								6	59.95	49.50	59.46	59.28	61.86	56.24
								Av.,	60.91	50.05	59.82	61.95	61.87	55.91
IV.,	English hay, "A," mostly *poa pratensis* in bloom, 900 gm.	11.54	6.34	10.04	32.67	48.53	2.42	1	61.52	43.80	59.48	66.00	61.90	48.11
								2	59.55	45.13	59.83	61.05	60.96	47.40
								3	62.61	47.94	63.09	64.77	63.69	48.27
								4	63.40	47.35	61.50	66.56	64.37	51.31
								5	63.13	45.92	61.69	66.05	64.36	50.03
								6	62.68	47.36	61.74	65.32	63.71	50.34
								Av.,	62.15	46.25	61.22	64.96	63.17	49.51
V.,	English hay, "A," mostly *poa pratensis* in bloom, 900 gm.	13.36	6.84	9.32	34.52	47.02	2.30	1	57.16	47.96	60.01	53.47	61.30	43.74
								2	60.15	47.95	62.22	59.00	62.85	48.51
								3	56.30	43.80	57.56	54.87	59.66	40.54
								4	57.33	52.59	61.39	53.69	60.22	49.33
								5	60.26	47.78	60.79	60.20	62.56	49.31
								6	60.11	49.45	62.16	59.60	62.08	50.94
								Av.,	58.63	48.26	60.76	56.81	61.45	47.11

Data of Digestion Experiments with Sheep, 1894-1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
VI.,	English hay, "A," mostly *poa pratensis* in bloom, 900 gm.	14.46	6.01	10.49	33.43	47.10	2.97	1	63.30	48.78	65.16	62.75	65.54	56.75
								2	61.73	48.87	64.87	58.79	65.11	56.17
								3	63.85	47.73	64.57	63.67	66.29	58.01
								4	63.28	48.25	65.45	64.58	64.19	56.88
								5	62.47	47.23	64.69	63.67	63.22	60.04
								Av.,	62.93	48.11	64.95	62.69	64.87	57.57
VII.,	English hay, "A," the same as VI., "A," sampled a year later.	10.13	4.44	9.78	32.71	50.45	2.62	-	63.00	48.00	65.00	63.00	65.00	57.50
II.,	Timothy hay, 850 gm., ...	7.60	6.16	9.64	33.98	47.22	3.00	1	55.09	-	57.15	55.52	54.72	56.76
								2	55.87	-	50.65	59.16	55.85	58.24
								Av.,	55.48	-	53.91	57.34	55.29	57.50
IV.,	English hay, mixed grasses, late cut, 900 gm., . .	11.94	5.64	9.39	34.73	48.32	1.92	2	52.39	22.39	51.18	55.26	54.44	36.53
								3	53.54	29.57	56.66	56.71	53.97	40.73
								Av.,	52.96	25.98	53.92	55.98	54.20	38.63

IV.,	English hay, mixed grasses, late cut, 900 gm.,	9.95	5.40	9.57	33.98	48.98	2.07	1	56.92	38.53	54.29	61.17	56.89	46.73
								2	56.57	45.65	56.27	57.07	58.08	42.10
								Av.,	56.74	42.09	55.28	59.12	57.49	44.42
I.,	Black grass, *Juncus Gerardi* (fed with 450 gm. English hay, I., "D"), 450 gm.	22.66	11.67	9.51	26.80	49.54	2.48	3	56.69	-	62.47	56.80	53.40	37.31
								4	62.35	-	63.29	64.20	59.29	45.77
								Av.,	59.52	-	62.88	60.50	56.34	41.45
III.,	Black grass, *Juncus Gerardi*, rather damp and mouldy (fed with 400 gm. English hay, III., "A"), 500 gm.	16.44	7.87	8.71	28.71	52.23	2.48	2	50.06	70.95	52.62	50.43	46.64	41.40
								3	51.37	66.96	52.57	56.06	46.44	44.39
								4	58.82	69.00	57.68	65.55	54.04	51.35
								Av.,	53.42	68.97	54.29	57.35	49.04	45.71
I.,	Branch grass, *Distichlis spicata* (fed with 400 gm. English hay, I., "D"), 600 gm.	18.13	10.29	8.27	26.47	52.76	2.21	3	56.68	-	63.19	56.06	55.20	35.57
								4	54.52	-	61.34	48.45	52.37	27.39
								Av.,	55.60	-	62.26	52.25	53.78	31.48
III.,	Branch grass, *Distichlis spicata*, in poor condition (fed with 400 gm. English hay, III., "A"), 500 gm.	22.98	7.85	7.87	26.46	55.00	2.82	2	49.43	58.19	52.16	56.63	45.25	34.53
								3	50.08	60.30	50.97	56.33	46.54	33.24
								4	49.54	55.90	51.93	56.27	45.42	42.17
								Av.,	49.68	58.13	51.69	56.41	45.74	36.65
I.,	Fox grass, *Spartina patens* (fed with 450 gm. English hay, I., "D"), 450 gm.	14.30	8.14	7.48	26.41	55.46	2.51	3	50.63	-	62.83	45.55	51.85	42.25
								4	54.82	-	62.48	55.19	54.68	51.03
								Av.,	52.70	-	62.70	50.37	53.26	46.64

Data of Digestion Experiments with Sheep, 1894-1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance.					Sheep Number.	Digestion Coefficients.					
			Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).		Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
I.,	Fox grass, *Spartina patens* (fed with 400 gm. English hay, I., "D"), 550 gm.	15.37	5.84	7.13	26.57	57.89	2.57	3	51.54	–	56.99	49.25	52.30	17.30
								4	54.11	–	57.41	53.39	51.20	30.26
								Av.,	52.80	–	57.60	51.30	51.50	23.80
III.,	Fox grass, *Spartina patens* (fed with 400 gm. English hay, III., "A"), 500 gm.	17.56	7.51	8.76	26.96	54.31	2.46	1	55.82	58.11	55.69	58.67	54.65	41.91
								2	52.94	59.31	61.19	53.64	51.28	31.26
								4	55.74	57.30	61.03	59.89	53.43	36.00
								Av.,	54.83	58.24	59.30	57.40	53.12	36.39
	Fox grass, *Spartina patens*.	–	–	–	–	–	–	–[1]	53.44	58.24	59.67	53.02	52.63	35.61
III.,	Salt hay, "cove mixture," black grass and red top (fed with 400 gm. English hay, III., "A"), 500 gm.	18.00	7.10	8.82	27.57	54.32	2.10	2	54.40	58.77	52.04	59.53	52.49	31.20
								3	52.57	57.17	46.49	56.92	51.16	48.03
								4	56.61	56.56	45.22	62.59	55.91	41.75
								Av.,	54.59	57.50	47.92	59.68	53.19	40.33

III.,	Salt hay mixture, fox and branch grasses, etc. (fed with 400 gm. English hay, III., "A") 500 gm.	16.00	9.98	6.48	26.77	54.26	2.51	2	52.18	67.83	42.32	53.91	50.57	30.18
								4	55.97	69.71	41.12	61.11	53.99	25.70
								Av.,	54.07	68.77	41.72	57.51	52.28	27.90
III.,	Red top hay, *Agrostis vulgaris*, bordering salt marsh, mixed with some sedge, over ripe (fed with 400 gm. English hay, III., "A"), 500 gm.	13.00	6.46	7.80	32.38	51.54	1.82	2	45.74	14.57	36.61	54.54	45.06	55.81
								3	45.94	9.19	36.75	54.62	46.37	47.13
								4	46.47	6.46	38.29	58.16	45.39	44.03
								Av.,	46.05	10.07	37.22	55.71	45.61	48.99
IV.,	Flat sage hay, *Spartina stricta maritima* var. (fed with 400 gm. English hay, IV., "A"), 500 gm.	17.00	9.79	7.82	29.71	49.77	2.91	2	55.39	61.41	50.70	59.75	53.67	32.67
								3	57.62	62.32	49.75	61.36	56.74	39.70
								4	56.55	62.15	54.86	60.16	54.75	36.06
								Av.,	56.52	61.96	51.77	60.42	55.05	36.14
I.,	Swale hay, fresh water grasses, sedges, brakes and wild flowers, 1,000 gm.	12.33	6.20	7.97	31.06	52.90	1.87	3	37.88	-	31.11	30.27	46.03	43.60
								4	39.89	-	36.66	35.66	45.99	43.61
								Av.,	38.88	-	33.88	32.97	46.01	43.60
V.,	Meadow fescue hay, *Festuca elatior pratensis*, early blossom, 900 gm.	12.73	6.60	7.33	37.89	45.96	2.22	2	60.29	46.49	53.29	66.79	58.49	53.05
								6	61.29	46.37	51.35	67.34	60.05	54.47
								Av.,	60.79	46.43	52.32	67.07	59.27	53.76

[1] Average of 7 sheep.

Data of Digestion Experiments with Sheep, 1894–1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter. (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
V.,	Tall oat grass hay, *Arrhenatherum elatius*, early blossom, 800 gm.	13.23	5.78	6.51	36.32	49.30	2.09	1	54.01	38.87	51.31	53.04	56.39	57.96
								6	56.56	43.40	50.53	56.67	59.00	53.62
								Av.,	55.27	41.14	50.92	54.86	57.69	55.79
VI.,	Tall oat grass hay, *Arrhenatherum elatius*, late blossom, 900 gm.	10.25	5.34	6.53	40.57	46.16	1.40	4	46.47	13.80	33.27	55.38	44.63	33.16
								5	50.02	25.15	38.08	59.58	46.54	37.29
								Av.,	48.25	19.48	35.69	57.48	45.59	35.23
VI.,	Canada blue grass hay, *Poa compressa*, in blossom, 900 gm.	10.75	5.65	6.86	36.40	48.87	2.22	1	61.97	40.91	42.96	69.94	62.22	38.13
								2	62.51	42.01	43.27	70.69	62.70	35.78
								Av.,	62.24	41.46	43.12	70.32	62.46	36.96
V.,	Kentucky blue grass hay, *Poa pratensis*, in blossom, 900 gm.	10.50	5.75	9.29	37.62	45.59	1.75	2	56.37	42.40	56.67	63.14	53.03	42.52
IV.,	Millet hay, *Panicum Italicum*, 800 gm., ...	12.52	6.34	4.66	35.98	51.38	1.64	3	51.81	15.73	32.08	60.17	52.42	47.72
								4	58.08	31.54	30.06	66.24	58.57	52.31
								Av.,	56.47	23.64	31.07	63.21	55.50	50.02

III.,	Barnyard millet, *Panicum crus-galli*, late blossom, fed green, 3,000 gm.	81.83	8.59	11.00	35.03	43.65	1.73	4	67.17	61.23	72.30	70.64	64.51	61.08
IV.,	Barnyard millet hay, late blossom, the same lot as preceding sample, (fed with 400 gm. English hay, IV., "A"), 500 gm.	12.67	10.18	10.73	34.48	43.05	1.56	1	57.10	62.99	63.69	59.82	52.26	44.18
								5	58.43	62.58	62.92	63.60	52.41	49.62
								6	56.88	63.89	64.39	61.36	50.07	45.21
								Av.,	57.50	63.15	63.67	61.59	51.58	46.34
VI.,	Barnyard millet, just heading out, fed green, 3,000 gm.,	83.36	8.77	10.18	33.60	45.48	1.97	1	67.08	50.94	61.22	71.57	68.71	54.83
								2	70.49	47.83	61.65	77.12	72.61	54.73
								3	67.44	45.09	58.11	73.18	70.19	53.91
								Av.,	68.34	47.95	60.33	73.96	70.50	54.49
VII.,	Barnyard millet hay, just heading out, the same lot as preceding sample, 900 gm.	12.33	9.04	10.24	36.38	42.88	1.46	1	58.75	50.58	56.37	66.42	54.84	49.39
								2	62.39	52.07	59.27	70.84	58.64	47.48
								Av.,	60.57	51.33	57.82	68.63	56.74	48.44
III.,	Barnyard millet, early blossom, fed green, 3,000 gm., .	81.12	7.84	8.44	32.06	49.92	1.74	2	71.51	64.79	66.59	70.94	74.10	61.39
								3	75.51	67.49	69.65	76.79	77.39	67.39
								Av.,	73.51	66.14	68.12	73.86	75.74	64.39
VI.,	Winter wheat and hairy or sand vetch hay (1½ — 1), 900 gm.	13.72	6.05	12.67	34.20	44.83	2.25	1	64.64	37.36	70.87	64.48	66.85	61.65
								2	64.18	35.70	71.89	63.09	66.71	63.07
								3	64.81	32.53	69.56	66.19	66.69	66.52
								Av.,	64.50	35.20	70.77	64.59	66.75	63.75

Data of Digestion Experiments with Sheep, 1894–1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
VI.,	Winter wheat and hairy or sand vetch (1 — 1) vetch predominating, in blossom, fed green, 3,000 gm.	83.52	9.04	19.58	30.88	37.59	2.91	1	68.51	46.46	77.21	66.85	71.59	56.37
								2	65.71	36.81	73.89	65.51	69.44	54.41
								3	68.40	44.15	77.71	65.80	72.37	57.47
								Av.,	67.54	42.47	76.27	66.05	71.13	55.65
VII.,	Winter wheat and hairy or sand vetch hay, the same lot as preceding sample, 900 gm.	11.90	9.05	19.38	32.21	36.91	2.45	1	67.90	59.63	76.04	64.21	69.24	61.61
								2	69.20	60.42	77.43	65.25	70.74	65.21
								3	67.89	58.19	77.12	63.94	69.15	63.56
								Av.,	68.33	59.41	76.86	64.47	69.71	63.46
VII.,	Winter wheat and hairy or sand vetch (1½ — 1), fed green (with 300 gm. English hay, VII., "A"), 2,000 gm.	79.57	8.63	15.38	29.34	43.73	2.92	3	68.78	42.23	68.86	69.72	73.71	54.48
								4	71.47	44.95	72.98	71.28	76.38	61.36
								Av.,	70.13	43.59	70.92	70.50	75.05	57.92
VI.,	Canada field peas, full blossom, fed green (with 300 gm. English hay, VI., "A"), 2,000 gm.	83.17	8.83	19.72	31.60	37.20	2.65	1	63.49	43.81	80.40	45.76	75.15	48.10
								2	64.88	40.24	79.26	52.44	74.31	53.36
								3	60.15	44.79	79.14	40.12	71.63	44.95
								Av.,	62.84	42.95	79.60	46.11	73.70	48.80

VII.,	Canada field peas, full blossom, fed green, 3,000 gm., .	86.19	8.81	21.31	28.09	38.48	3.31	1	63.59	32.63	81.49	44.58	75.08	58.42
								2	67.18	33.40	83.49	48.48	79.80	64.11
								3	61.14	26.38	79.75	39.69	74.83	56.89
								Av.,	63.97	30.80	81.58	44.25	76.57	59.81
VII.,	Hairy or sand vetch in blossom, fed green (with 300 gm. English hay, VI., "A"), 2,000 gm.	82.37	12.82	25.52	26.21	32.12	3.33	1	68.99	30.33	82.12	61.19	79.87	64.48
								2	72.51	28.65	81.40	70.37	84.13	68.99
								Av.,	70.75	29.49	81.76	65.78	82.00	66.74
III.,	Spring vetch and oats (1—1) in blossom, fed green, 3,000 gm.	83.10	8.70	12.78	35.48	40.34	2.70	2	67.17	54.81	75.96	67.85	67.76	47.63
								3	69.26	53.71	75.00	71.53	69.97	52.09
								4	64.70	49.45	73.33	65.47	65.98	41.93
								Av.,	67.04	52.66	74.76	68.28	67.90	47.22
III.,	Canada peas and oats (1—1), in blossom, fed green, 3,000 gm.	82.80	7.99	11.24	31.05	46.67	3.05	2	69.63	51.62	69.43	66.50	75.56	58.59
								3	72.01	51.20	73.21	70.32	77.12	61.19
								4	69.03	45.26	67.72	68.07	75.21	51.46
								Av.,	70.22	49.36	70.12	68.29	75.96	57.08
IV.,	Corn silage, Pride of the North corn, mature (fed with 400 gm. English hay, IV., "A"), 1,500 gm.	72.00	4.62	6.67	20.77	65.13	2.81	1	72.07	24.04	13.40[1]	73.44	80.90	72.05
								5	75.62	27.78	45.34	72.44	82.78	81.78
								Av.,	73.84	25.91	45.34	72.94	81.84	76.91

[1] Omitted from average.

Data of Digestion Experiments with Sheep, 1894–1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
II.,	Barnyard millet and medium green soy bean silage (fed with 400 gm. English hay, II., "A"), Sheep 1-2, 1,600 gm., Sheep 3-4, 1,800 gm.	81.67	10.55	12.01	36.07	37.12	4.25	1	54.40	-	58.13	57.47[1]	51.49[1]	75.93
								2	58.11	-	52.20	64.32	55.78	72.04
								3	57.95	-	41.79[1]	70.11	58.66	68.59
								4	64.75	-	61.94	73.89	63.29	80.00[1]
								Av.,	58.80	-	57.42	69.44	59.24	72.19
II.,	Corn and soy bean silage (2—1), Pride of the North corn and medium green soy bean (fed with 400 gm. English hay, II., "B"), 1,600 gm.	74.83	7.18	9.42	28.22	52.78	2.40	1	66.42	-	64.84	58.95	72.71	82.83
								2	68.62	-	63.07	64.74	74.31	79.81
								4	71.84	-	67.21	70.63	77.79	83.74
								Av.,	68.96	-	65.04	64.77	74.94	82.13
II.,	Cotton-seed feed, 4 parts hulls, 1 part meal, 850 gm.,	11.88	3.15	11.67	42.45	38.92	3.81	3	56.55	-	36.37	60.37	57.29	85.52
								4	57.57	-	41.86	57.33	59.75	92.65
								Av.,	57.06	-	39.12	58.85	58.52	89.09

III.,	Cotton-seed feed, 4 parts hulls, 1 part meal, 900 gm., .	11.79	3.73	12.21	37.83	42.16	4.07	1	54.74	34.68	42.17	50.89	59.84	93.78
								4	54.63	30.22	44.51	52.16	56.82	92.89
								Av.,	54.38	32.45	43.34	51.52	58.33	93.33
III.,	Cotton-seed feed, 4 parts hulls, 1 part meal (fed with 400 gm. English hay, III., "A"), the same lot as preceding sample, 500 gm.	12.24	-	-	-	-	-	2	57.74	23.52	41.23	59.99	59.84	98.38
								3	57.12	22.54	40.03	57.52	60.43	-
								Av.,	57.52	23.03	40.63	58.76	60.14	98.38
	Cotton-seed feed, average of six preceding tests, . .	-	-	-	-	-	-	-	56.29	27.74	41.03	56.38	58.99	92.64
V.,	Cleveland flax meal (fed with 700 gm. English hay, V., "A"), 150 gm.	10.46	5.82	40.37	9.88	41.32	2.61	1	85.21	23.28	84.05	-	93.98	53.25
								6	88.24	19.05	82.36	-	-	97.15
								Av.,	86.73	21.17	83.21	-	93.98	75.90
II.,	Pope cream gluten meal (fed with 700 gm. English hay, II., "A"), 150 gm.	8.20	.75	39.06	1.71	50.03	8.45	3	91.61	-	83.50	-	90.97	99.14
								4	94.89	-	84.00	-	95.35	-
								Av.,	93.25	-	83.75	-	93.16	99.14
II.,	Pope white gluten feed (fed with 600 gm. English hay, II., "A"), 250 gm.	9.24	1.36	27.92	6.72	55.79	8.21	3	85.90	-	84.52	75.61	90.36	82.02
								4	87.18	-	88.46	78.30	89.97	79.12
								Av.,	86.54	-	86.49	76.95	90.16	80.57
II.,	Buffalo gluten feed (fed with 600 gm. English hay, II., "A"), 250 gm.	8.42	.90	25.10	7.61	52.75	13.64	3	66.51	-	72.73	6.42	71.67	83.03
								4	69.25	-	74.80	11.65	72.56	85.62
								Av.,[2]	67.88	-	73.76	9.03	73.46	84.32

[1] Omitted from average.

[2] Digestibility apparently much too low.

Data of Digestion Experiments with Sheep, 1894–1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
III.,	Peoria gluten feed (fed with 600 gm. English hay, III., "B"), 200 gm.	8.53	1.02	22.72	7.15	63.03	6.08	1	93.61	-	84.59	99.77	97.81	89.00
								5	92.76	-	86.39	-	95.71	88.01
								6	87.64	-	82.79	84.94	92.93	83.77
								Av.,	91.34	-	84.59	92.35	95.48	87.59
VI.,	Germ oil meal (fed with 700 gm. English hay, V , "A"), 250 gm.	8.69	3.50	24.72	10.53	49.07	12.18	2	77.05	-	65.33	94.90	89.73	97.66
								3	82.59	-	72.89	-	83.58	95.46
								Av.,	79.82	-	69.11	94.90	86.66	96.66
V.,	Biles distiller's grain, brand R (fed with 600 gm. English hay, V., "A"), 250 gm.	8.89	2.18	17.93	13.69	60.11	6.09	5	55.61	-	56.29	-	61.09	80.06
								6	58.57	-	62.57	-	73.46	88.46
								Av.,	57.59	-	59.43	-[1]	67.28	84.26
V.,	Biles distiller's grain, brand X. (fed with 650 gm. English hay, V., "A"), 200 gm.	8.91	1.84	32.00	10.52	43.95	11.69	1	86.50	-	65.71	-	93.12	93.94
								3	87.07	-	80.05	-	85.15	97.60
								Av.,	86.78	-	72.78	-[1]	89.14	95.77

V.,	Biles distiller's grain, brand XX. (fed with 600 gm. English hay, V., "A"), 250 gm.	9.53	2.70	28.17	12.40	46.21	10.52	1	88.53	-	79.94	-	88.22	94.45
								6	79.77	-	76.50	-	79.77	94.87
								Av.,	84.15	-	77.22	-[1]	84.00	94.66
V.,	Biles distiller's grain, brand XXX. (fed with 600 gm. English hay, V., "A"), 250 gm.	7.46	2.22	32.27	11.11	41.62	12.78	2	79.88	-	73.41	-	78.03	91.78
								6	71.41	-	74.01	-	72.69	93.95
								Av.,	75.65	-	73.71	-[1]	75.36	92.87
V.,	Biles distiller's grain, brand XXXX. (fed with 600 gm. English hay, V., "A"), 250 gm.	8.83	1.86	38.13	12.50	36.74	10.77	1	79.82	-	72.08	-	81.12	96.99
								6	73.47	-	69.22	-	76.73	98.45
								Av.,	76.65	-	70.65	-[1]	78.93	97.70
IV.,	H-O dairy feed (fed with 650 gm. English hay, IV., "A"), 250 gm.	8.20	4.01	19.62	13.84	57.66	4.87	2	63.70	-	75.99	42.98	67.16	88.10
								3	66.84	-	79.64	38.69	72.61	82.83
								Av.,	65.27	-	77.82	40.84	69.89	85.47
VII.,	H-O dairy feed (fed with 650 gm. English hay, VII., "A"), 250 gm.	8.71	4.09	20.37	14.02	56.37	5.15	1	64.65	-	77.50	16.62	75.19	84.43
								2	64.82	-	67.93	41.75	73.99	83.23
								Av.,	64.74	-	72.72	29.19	74.59	83.83
IV.,	H-O horse feed (fed with 650 gm. English hay, IV., "A"), 250 gm.	9.79	3.42	14.33	10.92	67.16	4.17	2	63.46	-	61.20	8.32	76.17	81.17
								3	70.10	-	74.38	35.16	78.70	84.04
								Av.,[2]	-	-	-	-	-	-

[1] The digestibility of fibre varied so much that coefficients are omitted.

[2] The results taken of Sheep 3 only.

Data of Digestion Experiments with Sheep, 1894–1902 — Continued.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance. Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).	Sheep Number.	Digestion Coefficients. Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
VII.,	H-O horse feed (fed with 600 gm. English hay, VII., "A"), 300 gm.	11.20	3.57	13.39	10.32	68.53	4.19	2	74.40	-	64.90	52.34	84.88	78.49
								3	74.74	-	61.99	58.97	84.16	77.06
								Av.,	74.57	-	63.45	55.66	84.52	77.78
IV.,	Quaker oat feed (fed with 600 gm. English hay, IV., "A"), 300 gm.	7.41	5.39	11.97	19.02	59.67	3.95	1	63.30	-	82.35	44.05	68.14	91.52
								5	63.51	-	84.18	43.00	69.85	88.15
								6	59.04	-	76.87	40.66	64.27	87.24
								Av.,	61.95	-	81.10	42.57	67.42	88.97
VII.,	Quaker dairy feed (fed with 650 gm. English hay, VII., "A"), 250 gm.	8.62	5.06	15.07	17.27	58.84	3.76	1	64.08	-	69.07	56.45	70.50	75.67
								2	57.99	-	61.72	53.69	71.23	80.09
								Av.,	61.04	-	65.40	55.07	70.87	77.88
IV.,	Victor corn and oat feed (fed with 600 gm. English hay, IV., "A"), 300 gm.	9.56	3.75	10.21	12.42	69.44	4.18	1	73.75	-	65.70	35.90	84.89	84.39
								5	74.01	-	71.40	51.72	81.19	88.36
								6	76.45	-	75.41	57.75	82.76	87.74
								Av.,	74.74	-	70.84	48.46	82.95	86.83

V.,	Rye feed, bran and fine middlings (fed with 650 gm. English hay, V., "A"), 250 gm.	12.88	3.17	13.83	3.67	76.33	3.00	4	78.56	30.68	80.71	-	85.68	79.33
								5	84.91	48.19	82.14	-	89.27	90.81
								6	82.73	24.74	77.98	-	88.68	99.08
								Av.,	82.07	34.54	80.28	-	87.88	89.74
II.,	Rice meal (fed with 600 gm. English hay, II., "A"), 200 gm.	10.39	8.57	13.53	5.62	57.81	14.47	1	71.47	-	61.85	-	89.23	90.66
								2	76.19	-	37.36[1]	-	95.28	91.56
								Av.,	73.83	-	61.85	-	92.25	91.11
V.,	Chop feed, hulls bran and broken germs of maize (fed with 650 gm. English hay, V., "A"), 250 gm.	11.08	.93	12.10	14.06	66.75	6.16	1	71.30	-	64.02	58.83	75.56	86.41
								2	92.29	27.54	76.77	-	92.07	85.46
								3	77.47	-	62.64	70.12	82.96	75.60
								Av.,	80.35	27.54	67.81	64.48	83.53	82.49
III.,	Cerealine feed (fed with 600 gm. English hay, III., "A," and 100 gm. Chicago gluten meal), 150 gm.	12.10	2.53	10.85	5.00	74.03	7.59	1	89.59	-	69.69	-	92.62	77.54
								5	92.24	-	79.41	92.41	96.36	83.23
								6	89.33	-	80.59	72.08	96.88	80.94
								Av.,	90.39	-	80.00	82.24	95.29	80.57
VI.,	Corn bran (fed with 500 gm. English hay, VI., "A"), 400 gm.	16.56	1.52	10.27	14.80	68.60	4.81	4	69.87	-	55.22	64.68	74.06	80.25
								5	71.44	-	55.48	64.64	75.82	85.17
								Av.,	70.66	-	55.35	64.66	74.94	82.71

[1] Omitted from average.

Data of Digestion Experiments with Sheep, 1894–1902 — Concluded.

Series.	Kind and Amount of Food a Day.	Water Content as fed (Per Cent.).	Composition of Water-free Substance.					Sheep Number.	Digestion Coefficients.					
			Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).		Dry Matter (Per Cent.).	Ash (Per Cent.).	Protein (Per Cent.).	Fibre (Per Cent.).	Nitrogen-free Extract (Per Cent.).	Fat (Per Cent.).
V.,	Parson's $6 feed, grain hulls and mill sweepings (fed with 600 gm. English hay, V., "A"), 300 gm.	11.22	8.88	11.23	20.10	57.41	2.38	1	56.37	13.88	61.96	49.55	62.54	81.07
								3	55.12	10.49	56.23	44.66	64.88	80.00
								Av.,	55.75	12.19	59.09	47.11	63.71	80.54
V.,	Oat feed, inferior (fed with 600 gm. English hay, V., "A"), 250 gm.	9.89	6.23	5.60	30.27	56.30	1.60	1	29.32	9.75	65.29	24.67	29.16	96.94
								2	38.22	20.72	69.26	37.47	35.81	88.89
								3	34.78	8.12	50.95	34.50	35.24	89.17
								Av.,	34.11	12.86	61.83	32.21	33.40	91.67

Influence of Drying and Curing on Digestibility.

Jordan[1] summarized the results of six experiments made to throw light on this point, and states that in only two cases (clover and corn fodder) was there any decrease in digestibility due to drying. Experiments were made at this station with wheat and vetch and barnyard millet, and the results are found in the above tables. It will be seen that in case of the wheat and sand vetch no important difference was noted as a result of the curing process, while in both experiments drying noticeably decreased the digestibility of barnyard millet. Generally speaking, the mere withdrawal of the water is not supposed to affect digestibility, and this is likely to be especially true with young and tender plants and with the finer grasses. In the case of plants with coarse, tough stems, the reverse is likely to be true. The hardening of the woody stems in the curing process and the less perfect mastication resulting, as well as possible chemical and physiological changes, are all factors which may cause lessened digestibility.

Digestion experiments enable the investigator to form a reasonably correct opinion concerning the nutritive and economic value of the different coarse and concentrated feeds. The results of these experiments are presented from time to time in popular bulletins treating of feed and feeding.

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[1] Bulletin No. 77, U. S. Department of Agriculture: The Digestibility of American Feeding Stuffs.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANT, H. M. THOMSON.

The work of the agricultural division of the Experiment Station has followed the general lines of earlier years. It has for its chief object to obtain light on some of the numerous conditions determining productiveness, chiefly as affected by different manures and fertilizers used alone and in a wide variety of combinations. The questions connected with the use of manures and fertilizers are self-evidently of vital importance in our agriculture, which cannot, as in some of the newer States of the Union, depend upon the accumulated fertility of ages. Equally self-evident to every intelligent mind must be the fact that the solution of even the simplest problem connected with the use of manures is a matter of much inherent difficulty, so numerous are the conditions which determine production, — conditions, too, many of which are beyond control. It is clearly perceived that much caution should be exercised in drawing conclusions from the results of experiments; that field results especially should be tested again and again, under varying conditions of soil and season; that such results obtained on plots inevitably varying somewhat in natural fertility should be checked by results obtained on equal quantities of thoroughly mixed soils from the same plots under conditions made as nearly normal as possible; as well as by vegetation experiments in plots, where all the conditions of moisture, — exposure, etc., are most perfectly under control. Our work, therefore along these lines includes three distinct methods of experiment: first, plot experiments in the open field; second, closed plot experiments (plunged cylinders) with mixed soil; and third, vegetation experiments in pots.

In connection with lines of inquiry pertaining to the use of manures and fertilizers and in the other lines of work mentioned below we have cared for 251 plots upon our own grounds and have supervised work upon 20 plots in different parts of the State. In our experiments with mixed soil in enclosed plots (plunged cylinders) we have employed 153 cylinders. In our vegetation experiments we have cared for 278 pots.

Variety tests also have received considerable attention. The test with corn, which has included 31 varieties, will not be reported, as the grain is not yet dry enough to shell. We have had under careful observation some 70 species of grasses and forage crops, in addition to 18 varieties of millets. In connection with the grasses we are endeavoring to gain some light as to the relative value of the different kinds for pastures as well as for mowings by lawn-mowing one-half of each plot. We have obtained some striking results, but these will not be reported until we have carried the test further. The work with poultry has been for the most part along the lines which have engaged our attention in previous years, viz., a study of the best methods of feeding for eggs. In connection with our poultry work we are making comparative trials of various types of incubators and brooders, which are being used in raising the fowls we use in our feeding experiments. We are also making careful records touching the food cost of raising chickens.

In this report we shall discuss briefly the results obtained in a portion only of the plot experiments pertaining to the use of manures and fertilizers, selecting for this purpose the results which are confirmed by the greatest number of years' work, as well as in many cases by the closed plot and pot experiments. We shall report also the results of the variety test with potatoes, and shall make a brief statement touching the results obtained in experiments with poultry. The nature of the subjects of inquiry and the more important features of our results will be made clear by the following statement: —

I. — To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia, and dried blood as

sources of nitrogen. The crop of this year, potatoes, gives yields on the basis of which the materials rank in the following order: dried blood, sulfate of ammonia, barnyard manure, nitrate of soda. The yield on the last two is, however, below the yield on the plots receiving no nitrogen, and the results are complicated by the fact that the crop suffered from blight and rot. The average to date ranks the materials in the following order: nitrate of soda, barnyard manure, sulfate of ammonia, and dried blood.

II. — To determine to what extent, if any, the introduction of a crop of the clover family will make the application of nitrogen to the following crop unnecessary. Potatoes this year followed soy beans, and gave a yield on the no-nitrogen plots equivalent to 99.3 per cent. of that obtained on the plots to which nitrogen has been yearly applied.

III. — To determine the relative value of muriate and high-grade sulfate of potash for field crops. The results of the year indicate sulfate to be superior to the muriate for cabbages, mixed timothy and clover, and potatoes as indicated by the yield of merchantable tubers. The results with onions were indecisive as the crop failed to mature, largely, it is believed, on account of the cold summer.

IV. — *A*. To determine the relative value of nitrate of soda, sulfate of ammonia, and dried blood, used in connection with manure as sources of nitrogen for garden crops. The results indicate these materials used in amounts furnishing equal nitrogen to rank in the following order: nitrate of soda, dried blood, sulfate of ammonia. *B*. To determine the relative value of sulfate and muriate of potash for garden crops. The results of the year indicate the sulfate of potash to be the better for onions, tomatoes and celery; while the muriate has given slightly superior results with strawberries and squashes.

V. — To determine the relative value of different potash salts for field crops. The salts under comparison are high-grade sulfate, low-grade sulfate, kainite, muriate, nitrate, carbonate, and silicate. The crop of this year was clover. The potash salts giving the best yields are the silicate, high-grade sulfate, and nitrate. The most striking result brought

out is the injury to young clover in a cold, wet spring, due to potash salts containing chlorine, especially to the kainite.

VI. — To determine the relative value of phosphates used in quantities furnishing equal phosphoric acid to each plot. The crop of this year was onions; and the phosphates giving the best results, and the only ones which can be considered even fairly satisfactory, in the order of their rank, are: dissolved bone meal, fine-ground raw bone, phosphatic slag, and the steamed bone meal. Two gave results very much inferior to all others, viz., Tennessee phosphate and Florida soft phosphate.

VII. — *A*. Soil test with corn. The results of this year indicate that potash to a far greater extent than any other plant-food element controls the yield of corn. Muriate of potash alone at the rate of 160 pounds per acre annually for fourteen years gives this year a yield at the rate of 47.7 bushels of shelled grain per acre. The combination of dissolved bone-black with the same amount of muriate of potash gives a crop of 55.9 bushels of shelled grain per acre. *B*. Soil test with potatoes. The results of the year indicate that the muriate of potash on the limed portion of the field increased the crop more than either of the other fertilizer elements; but the potato crop is increased to a considerably greater extent by the use of materials furnishing phosphoric acid and nitrogen than was the corn in the other soil test.

VIII. — To determine the relative value for the production of corn and mixed grass and clover in rotation of a large application of manure, as compared with a smaller application of manure in connection with a potash salt. The crop of this year was mixed grass and clover. The manure alone gave crops somewhat larger than the combined manure and potash, but, owing to the lesser cost of the combination, the financial result is in its favor.

IX. — To determine the relative value for crop production of two fertilizer mixtures, one furnishing the important elements of plant food in the same proportion in which they are found in the average of corn fertilizers offered in our markets, the other containing less phosphoric acid and

more potash, the crops being corn and mixed grass and clover in rotation. The crop of this year was mixed grass and clover. The result is a yield at the rate of 1,520 pounds per acre more on the fertilizer mixture containing the greater amount of potash; and this superior crop is produced at a cost per acre for fertilizers of about $4 less than the combination of materials used on the other plots. The nutritive value of the hay from the plots receiving the greater amount of potash is superior to that from the other plots, on account of the greater relative abundance of clover.

X. — To determine the economic result of using in rotation on grass lands: the first year, wood ashes and nitrate of soda; the second year, ground bone, muriate of potash, and nitrate of soda; and the third year, barnyard manure. The yields amount on the average to about 2 tons per acre, produced at a cost for manure and fertilizers making their application decidedly profitable.

XI. — To determine which is the better practice, — to spread fresh manure directly on the field during late autumn or winter, or to put into large piles in the field at the same time, these piles to be spread and immediately ploughed in in the spring. The field where this experiment is tried has a moderate slope. The crop of this year was corn, and the results were on the whole quite favorable to the spring application, although the difference in the yield this year was not sufficient to repay the cost of the extra handling.

XII. — To determine whether the use of nitrate of soda for rowen is profitable. The application of nitrate to a timothy sod at rates varying from 150 to 250 pounds per acre gives a marked increase in every case, — an increase more than sufficient to cover the cost of nitrate and its application.

XIII. — Variety test with potatoes. The varieties giving yields exceeding 250 bushels of merchantable tubers per acre, mentioned in the order of productiveness, are: Beauty of Hebron (first generation from Maine seed), Beauty of Hebron (second generation from Maine seed), I. X. L., Steuben, Early Nancy, Million Dollar, Ensign Bagley,

Early Rose, Gem of Aroostook, and Daughter of Early Rose. It is significant that the old variety — the Beauty of Hebron — outranks all other varieties; while the still older Early Rose is exceeded by only 6 out of the 31 varieties.

XIV. — To determine the best nutritive ration in feeding hens for eggs. The results of the year appear to indicate that if materials carrying considerable fat are used in combination with rations in which wheat and corn respectively are most prominent, the wheat slightly surpasses the corn; but that if fat be not freely supplied in connection with such rations, the corn is superior to wheat. Corn and buckwheat compared, without materials furnishing any considerable amount of fat, give results markedly favorable to corn.

I. — The Relative Value of Manures furnishing Nitrogen. (Field A.)

A full description of the plan of the experiment in this field will be found in the twelfth annual report. The object is to determine the relative value for various crops of a few of the standard materials which may be used on the farm as a source of nitrogen. The materials under comparison are barnyard manure, nitrate of soda, sulfate of ammonia, and dried blood. These wherever used are applied in such quantity as to furnish equal amounts of nitrogen. To three plots in the field no nitrogen in any form has been applied. All the plots in the field receive the same amounts of materials furnishing phosphoric acid and potash and in liberal quantities. Barnyard manure is the source of nitrogen on one plot, nitrate of soda on two plots, sulfate of ammonia on three plots, and dried blood on two. This experiment was begun in 1890, and the crops which have been grown previous to this year in the order of succession are: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, and soy beans. As the result of all experiments previous to this year, it is found that the materials furnishing nitrogen have produced crops ranking in the following order: —

	Per Cent.
Nitrate of soda,	100.0
Barnyard manure,	91.8
Sulfate of ammonia,	90.0
Dried blood,	87.7
The plots receiving no nitrogen,	71.0

The crop for this year was potatoes, which therefore follow a leguminous crop, — the soy bean. After the beans were harvested rye was sown as a cover crop, but the season of sowing was so late that it had made but little growth when the land was ploughed for potatoes this spring. The variety of potatoes grown was Beauty of Hebron. The seed stock used was grown in northern Maine. On April 10 it was treated in the customary way in solution of corrosive sublimate for prevention of scab. The seed was then spread in a single layer in a sunny room, where it remained until May 5. The seed stock was of excellent quality, the tubers in general smooth and of good size. Before planting they were cut to pieces of two good eyes each. They were planted in rows 3 feet apart and 1 foot apart in the rows. It is a matter of regret that the stock of seed reserved for this field proved not quite sufficient. Plots 0 to 2 and a part of 3 were planted with seed also grown in Maine, of the White Maine variety. This also was treated with corrosive sublimate solution, and before planting cut to pieces of two eyes. It was not, however, budded before planting. Growth throughout the early part of the season was normal and good. The crop was sprayed four times with Bowker's Boxal, which, as in other experiments, proved effective in destroying bugs, but did not entirely prevent blight. The dates of spraying were June 19 and 28, and July 11 and 26. Much care was taken in spraying, and it is believed that the fact that blight was not entirely prevented was due to the use of nozzles which threw the spray only on the upper surfaces of the leaves. Blight was quite general, although only just beginning, on August 12. By August 27 the tops were nearly all dead, except that a few scattering plants were still green at the tips on plots 0, 1, 2 and 3, and that the top leaves of the plants were generally green on plots 5, 6 and 8. The last three plots are those, as will be seen

by the table below, to which sulfate of ammonia was applied; and it seems likely that this longer persistence of life in the tops was connected with the retarded growth due to the fact that the nitrogen of the sulfate of ammonia probably became available relatively late in the season. Digging the crop was commenced on August 29 and finished September 6. Those plots were dug first on which it was believed there was most decay. Some rotten tubers were found on all plots, those affected being generally of large size. The amount of rot, so far as can be judged, does not appear to have been affected by the nature of the fertilizers used, for we find very wide variations between plots all of which were similarly manured. The fertilizer treatment and the yields on the several plots are shown in the following table: —

Yield of Potatoes per Acre (Bushels).

Plots.	Nitrogen Fertilizer.	Merchantable.	Small.	Rotten.
0	Barnyard manure,	132.00	19.50	16.33
1	Nitrate of soda,	119.67	15.50	8.33
2	Nitrate of soda,	104.17	18.67	21.67
3	Dried blood,	136.17	24.50	27.17
4	No nitrogen,	93.33	42.50	32.67
5	Sulfate of ammonia,	129.83	35.67	1.50
6	Sulfate of ammonia,	153.83	34.67	14.50
7	No nitrogen,	116.33	50.17	19.17
8	Sulfate of ammonia,	102.00	34.00	27.00
9	No nitrogen,	119.67	40.00	9.17
10	Dried blood,	157.67	32.83	37.67

The average results are as follows: —

Fertilizer.	Merchantable (Bushels).	Small (Bushels).	Rotten (Bushels).
Average of the no-nitrogen plots (3),	109.78	44.22	20.34
Nitrate of soda plots (2),	111.92	17.09	15.00
Dried blood plots (2),	146.92	28.67	32.42
Sulfate of ammonia plots (3),	128.55	34.78	17.89

The relative standing of the different materials furnishing nitrogen, calling the one giving the largest yield 100, is as follows: —

	Per Cent.
Dried blood,	100.00
Sulfate of ammonia,	87.10
Barnyard manure,	80.68
Nitrate of soda,	69.22
No nitrogen,	83.80

The nitrate of soda stands relatively much lower than in previous experiments on this field. The past season was exceptionally rainy, and there may have been some loss of the nitrate, all of which was applied just before planting. Such loss would not, however, account for the fact that the yield on the nitrate is below that on the no-nitrogen plots; and we are compelled to conclude that the fact that normal development and ripening were interfered with by the prevalence of blight and rot has prevented the several fertilizers from exerting a full normal effect. In estimating the significance of the results, we must not, however, lose sight of the fact that the crop of last year was a legume (the soy bean), and that the great abundance of nodules upon its roots indicated that it developed under conditions making possible a very large assimilation of atmospheric nitrogen.

II. — Crops of the Clover Family (Legumes) as Nitrogen Gatherers.

This experiment is carried out in connection with experiments to determine the relative value of different materials furnishing nitrogen on Field A. Both soy beans and clover have been used previous to the present season, the former during three years and the latter for one year. The crop of both is harvested. Our object is to test, not the effect of ploughing under these crops, but simply the improvement following the introduction of each derived from their roots and stubble. Previous to the present year the results have indicated little or no improvement in the condition of the soil following the culture of the soy bean, and a very great improvement followed the turning under

of the clover sod, as shown by the fact that the potato crop of 1900 grown upon the clover sod was almost as good where no nitrogen fertilizers have been used for eleven years as it was where such fertilizer has been annually used in fairly liberal amounts. The crop in 1901 was soy beans. For the present season it was potatoes. The average yields for this year as well as for the previous years during which the experiment has continued are shown by the table : —

Effect of Leguminous Crops upon the Following Crop (Pounds).

Plots (Each One-tenth).	1890.	1891.	1892.	1893.	1894.	1895.	1896.
	Oats.	Rye.	Soy Bean.	Oats.	Soy Bean.	Oats.	Soy Bean.
Nitrogen plots,	343	484	1,965	598	620	494	1,740
No-nitrogen plots,	290	421	1,443	540	452	370	1,143

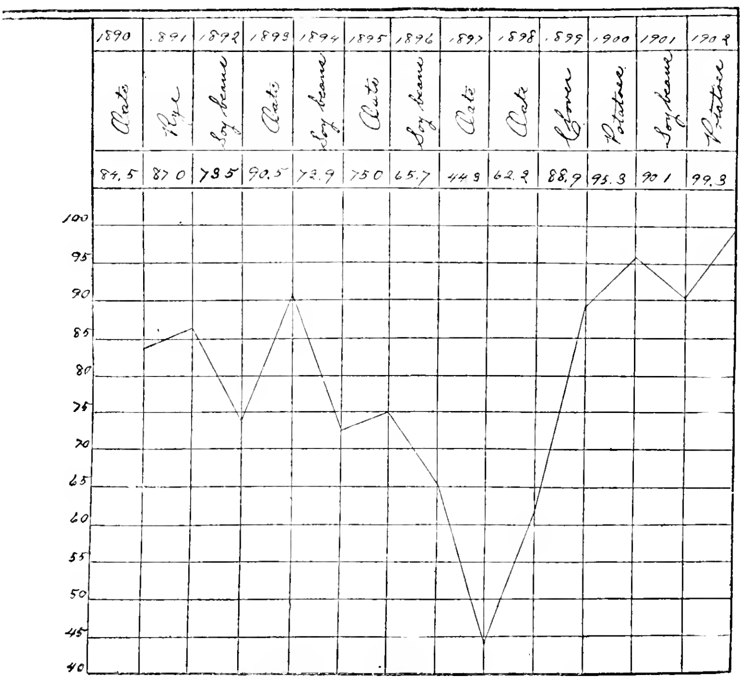
Effect of Leguminous Crops upon the Following Crop (Pounds) — Concluded.

Plots (Each One-tenth).	1897.	1898.	1899.	1900.	1901.	1902.
	Oats.	Oats.	Clover.	Potatoes.	Soy Bean.	Potatoes.
Nitrogen plots,	445	254	413	1,316	442.2[1]	1,053.6
No-nitrogen plots,	197	158	367	1,254	398.3[1]	1,046.0

[1] Dry beans and straw.

There are three plots in the field which have received neither manure nor fertilizer supplying nitrogen since 1884, and the figures showing yields are the averages for these plots. The figures for the nitrogen plots show the average products of the eight plots in the field which have yearly received an application of materials furnishing nitrogen in fairly liberal amounts. These materials are as follows: barnyard manure, one plot; nitrate of soda, two plots; sulfate of ammonia, three plots; and dried blood, two plots. At the rates at which they are used, these materials furnish 45 pounds of nitrogen per acre, and they are so used that

each plot receiving a nitrogen fertilizer receives annually the same number of pounds of nitrogen. The past season is the eighteenth since the no-nitrogen plots have been manured with anything containing nitrogen. The curve below shows the per cent. which the yield on these plots constitutes of the yield on the plots manured with nitrogen.



That the crop of potatoes on the no-nitrogen plots this year amounts to 99.3 per cent. of the crop on the plots receiving nitrogen is a fact of much significance. In the earlier years of this experiment, as has been stated, the crops following soy beans have not appeared to derive any considerable benefit from the roots and stubble of this crop. For this year it is believed that we must conclude the benefit is considerable. This difference in the after-effect of the soy beans is possibly explained in part by the fact that the bacteria, whose presence is essential to the acquisition of atmospheric nitrogen, are now more abundant in this soil than during the earlier years when soy beans were grown;

but it may be that the relative standing of the no-nitrogen plots is higher than it would have been had the crop of potatoes grown to normal maturity. It will be remembered that blight and rot prevailed to a considerable extent, and these would naturally injure the potatoes with the ranker growth more than those where the growth was less luxuriant. It does not seem, therefore, that we are justified in concluding that the after-effect of the soy beans is as useful as the relation between the figures appears to indicate.

III. — The Relative Value of Muriate and High-grade Sulfate of Potash. (Field B.)

The object of this experiment, which has been in progress since 1892, is to determine the relative value for different crops of the two leading and cheapest sources of potash, viz., muriate and high-grade sulfate. These salts are used in equal quantities continuously upon the same land. The field contains eleven plots, of approximately one-eighth of an acre each. Of these, six have been yearly manured with muriate of potash and five with the high-grade sulfate. From 1892 to 1899 inclusive these salts were used at the rate of 400 pounds per acre; since 1900 the rate of application has been 250 pounds per acre. Fine-ground bone at the rate of 600 pounds per acre has been yearly applied to all plots. Various crops have been grown in rotation, including potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans, and cabbages. Most of these crops have been grown during several different years. All have with few exceptions given uniformly large yields. The results to date may be summarized as follows: among the crops grown, the potatoes, clovers, cabbages, and soy beans have usually done much the best on the sulfate of potash; the yield of corn, grasses, oats, barley, vetches and sugar beets has been about equally good on the two salts; the quality of the potatoes and sugar beets produced on the sulfate of potash plots has been distinctly better than that of the crops produced on the muriate of potash.

The crops of the past year have been mixed timothy and clover, cabbages, potatoes, and onions.

1. Timothy and Clover (Sulfate v. Muriate of Potash).

Mixed timothy and clover occupied two plots which were seeded in July, 1901. The proportion of clover on the sulfate of potash plot was distinctly greater than on the other. The variety of clover was the alsike. The yields are shown in the table: —

Muriate v. High-grade Sulfate of Potash. — Timothy and Clover Hay per Acre (Pounds).

	Muriate of Potash.	High-grade Sulfate of Potash.
Hay,	4,710	4,725
Rowen,	1,745	1,997
Totals,	6,455	6,722

It will be seen that there is no considerable difference in the amount of hay yielded by the two potash salts. The first crop, indeed, in which of course timothy was relatively abundant, was practically equal upon the two. There is more difference in the rowen crops, which is without doubt a consequence of the better growth of the clover (which furnishes most of the rowen) on the sulfate of potash. Our results, then, are confirmatory of those in previous years, which have tended to show that, especially in cool and wet seasons, clover does better upon sulfate than upon muriate of potash. The experiment of the present season upon another of our fields (Field G), to be reported later, is also strikingly confirmatory of this general principle.

2. Cabbages.

Cabbages occupied two plots (17 and 18) on which clover was grown last year; and a considerable growth of mixed white and alsike clover, with some sorrel and weeds, was ploughed in a few days before planting the cabbages. The variety of cabbage grown was the All Seasons, from Gregory & Son, Marblehead. The seed was planted in hills 3 by 2½ feet apart on June 16. A very heavy shower interrupted the work, and so packed the soil on the muriate

of potash plot, where the planting had been completed, that germination was imperfect; while on the other plot, where the seed was put in after the shower, the stand of plants was good. When the plants were finally thinned and vacancies filled, it was found necessary to use some plants from the sulfate of potash plot to fill vacancies on the other plot. The summer proved so cool that the crop did not fully mature on either plot, as growth was unusually slow. The yields are shown in the table: —

Muriate v. High-grade Sulfate of Potash. — Cabbages, Yields per Acre.

	Muriate of Potash.	High-grade Sulfate of Potash.
Hard heads (number), ...	2,648	3,420
Hard heads (pounds), ...	26,063	35,550
Soft heads (pounds), ...	22,650	18,263

It will be noticed that the total yield of hard heads on the sulfate of potash was materially greater than on the other plot. The merchantable value of the hard heads on the two plots, at ½ cent per pound was, respectively, for the muriate of potash $130.32, for the sulfate $177.75; the sulfate, therefore, gave a crop worth $47.43 per acre more than the muriate. The sulfate in the quantity used cost less than 70 cents per acre more than the muriate. The result of this year is in exact agreement with the result obtained in 1899, when, as this year, the season was rather cold and rainy. When the seasons are hot and relatively dry, the difference between the two salts is comparatively small, and sometimes the muriate gives a slightly better crop than the sulfate. It seems evident, however, that on all except the lightest soils the sulfate is the safer of the two potash salts to employ for the cabbage crop.

3. *Potatoes* (*Sulfate v. Muriate of Potash*).

The potatoes grown in this experiment occupied two plots, 15 and 16. For the two preceding years these plots had been in clover, the clover sod being turned on April 15.

The variety of potatoes was Beauty of Hebron, and the seed stock was purchased in northern Maine. It was prepared for planting by treating with corrosive sublimate on April 10, exposed in a light room in a single layer until April 22, and then cut into pieces of two eyes each. The pieces were planted 1 foot apart in rows 3 feet apart the same day the tubers were cut. The crop was thoroughly cared for throughout the season. It was sprayed with Bowker's prepared insecticide and fungicide four times, June 19 and 28, and July 11 and 26. As in our other experiments, the spraying proved thoroughly effective in destroying bugs, but not entirely so in preventing blight and rot. The growth on both plots was vigorous, and from a very early period there was a marked difference in the shade of green on the two; the vines on the sulfate of potash plot were of a dark-green color, those on the muriate of potash plot were of a light-yellowish — or pea-green color. This difference persisted until the crops began to ripen. On August 5 the tops were generally beginning to show signs of ripeness. On the 12th, blight was general, though not apparently severe. The tops were entirely dead on August 29, on which date the potatoes were dug. They were divided into two grades as to size, the potatoes classed as small including those estimated to be below 2 ounces in weight. There was considerable rot, as a rule of the larger tubers only. The total weight of the decayed potatoes on the muriate of potash plot was 50 pounds, on the sulfate of potash plot 314 pounds. In the estimate of total product these tubers are included with the merchantable. The yields were at the rates per acre shown in the table: —

Muriate v. High-grade Sulfate of Potash. — Potatoes, Yield per Acre (Bushels).

	Muriate of Potash.	High-grade Sulfate of Potash.
Potatoes, merchantable,	208	215
Potatoes, small,	53	39
Totals,	261	254

The total yield on the two plots is nearly the same. The crop on the sulfate of potash averaged of larger size than that on the muriate, but there was most decay on the sulfate. Whether this fact has any special significance it is impossible to say, without repeating the experiment.

4. *Onions (Sulfate v. Muriate of Potash).*

The onions grown in this experiment occupied two plots, 19 and 20. The crop of last year on these plots was cabbages, with winter rye as a cover crop, sown before the cabbages were harvested. The variety of onions was Danvers Yellow Globe. The seed was obtained from Gregory & Son, Marblehead, 1901: it was therefore one year old. It was sown in the thoroughly prepared soil in rows 14 inches apart on April 24. Growth throughout the earlier part of the season was very slow, and the final crop was poor. The fertilizers usually employed on this series of plots were supplemented by the application of a combined form of quick-lime and nitrate of soda, known as "niterlime,"[1] at the rate of 175 pounds per acre. This was applied on July 12 and cultivated in. Soon after its application growth became much more rapid; but whether this was due chiefly to the somewhat more seasonable weather which then prevailed, or to the application of niterlime, we cannot feel certain. The onions were pulled on September 23, those on the sulfate of potash being more nearly mature than those on the other plot. The yield per acre, in bushels of sound onions and pounds of scallions, is shown in the table: —

Muriate v. High-grade Sulfate of Potash. — Onions, Yield per Acre.

	Muriate of Potash.	High-grade Sulfate of Potash.
Onions (bushels), ...	110	75
Scallions (pounds), ...	10,811	8,828

[1] Niterlime contains: nitrogen, about 10.5 per cent.; and lime, about 20 per cent.

It will be seen that the muriate of potash has given the larger yield; but, since the onions on the sulfate were riper than those on the muriate, the figures probably have no special significance.

IV. — Fertilizers for Garden Crops. (Field C.)

The conclusions now presented are based upon the results of experiments which have been in progress since 1891. From that date to 1898 chemical fertilizers alone were used. During the past five years stable manure has been applied in equal quantities (at the rate of 30 tons per acre) to each of the plots, while the chemical fertilizers have been used in the same amounts and applied to the same plots as at first. The crops grown during this series of years have included all important out-door crops: spinach, lettuce, onions, garden peas, table beets, early cabbages, late cabbages, potatoes, tomatoes, squashes, turnips, sweet corn, celery, and one small fruit, — strawberries. Two of the perennial garden crops, asparagus and rhubarb, have now been planted, but these will not be discussed in the present report. Experiments have been planned with reference to throwing light especially upon two points: —

A. The relative value of nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen.

B. The relative value of sulfate of potash and muriate of potash.

These two points will be separately discussed.

A. — The Relative Value of Nitrate of Soda, Sulfate of Ammonia and Dried Blood as Sources of Nitrogen.

The three fertilizers used as sources of nitrogen have from the first been applied in such amounts as to furnish equal nitrogen to each plot, and each fertilizer is always applied to the same plot. Each of the nitrogen fertilizers is used on two plots, — on one with sulfate of potash, on the other with muriate. Dissolved bone-black as a source of phosphoric acid is applied in equal quantities to all plots. The results previous to this year may be thus summarized: —

For the early crops, *i.e.*, the crops making most of their

growth before midsummer, including onions, lettuce, table beets, garden peas, and strawberries, the nitrate of soda has been found the most effective source of nitrogen. The relative standing of the different nitrogen fertilizers is as follows: —

	Per Cent.
Nitrate of soda,	100.0
Dried blood,	92.7
Sulfate of ammonia,	54.8

For late crops, including cabbages, turnips, and celery, the relative standing is: —

	Per Cent.
Nitrate of soda,	100.0
Dried blood,	98.7
Sulphate of ammonia,	77.5

The average rate of yield per plot for each of the nitrogen fertilizers for the present season is shown in the following table: —

Nitrogen Fertilizers compared for Garden Crops. — Yield per Plot (Pounds).

Average of Two Plots.	Onions.		Tomatoes.		Strawberries.	Celery.	Squashes.
	Ripe.	Scallions.	Ripe.	Green.			
Nitrate of soda,	367.5	29	235.9	264	125.8	360	841.3
Sulfate of ammonia,	209.5	94	242.1	345	128.4	180	819.6
Dried blood,	357.0	34	403.7	269	146.4	295	807.4

It will be seen that for most of the crops the results are similar to the average results of preceding years. Nitrate of soda, however, stands relatively somewhat lower. Combining the results of this year with those of previous years, the relative standing of the different fertilizers used as sources of nitrogen is as follows: —

For the early crops, including onions and strawberries: —

	Per Cent
Nitrate of soda,	100.0
Dried blood,	93.7
Sulfate of ammonia,	57.3

For the late crops, including tomatoes, celery, and squashes : —

	Per Cent.
Nitrate of soda,	100.0
Dried blood,	99.0
Sulfate of ammonia,	78.4

Since nitrate of soda furnishes a pound of nitrogen at lower cost than any other of the fairly concentrated fertilizers, it becomes very evident, in view of our results, that it should be used as the source of this element as largely as the nature of the conditions permits. It should be remembered, as has been stated in previous reports, that the soil of Field C is a moderately retentive loam. Upon a lighter soil the superiority of the nitrate would probably be less marked. It must again be pointed out that experiments here, as elsewhere, make it very probable that the relative standing of the sulfate of ammonia would be bettered by making a heavy application of lime to the plots where it is used. Since, however, the pound of nitrogen costs more in the sulfate of ammonia than in either the nitrate or the dried blood, it would seem that there can be little probability that the selection of this nitrogen fertilizer is usually wise. Its physical properties, it is true, are such that it is more readily and conveniently used in mixtures with other materials than the nitrate, since the latter attracts moisture, while the sulfate of ammonia does not do this to any considerable extent. If, however, nitrate of soda which has been recently reground and which has been stored in a dry place be used, and if the mixture can be applied soon after it is made, there is little difficulty in employing nitrate.

B. — The Relative Value of Sulfate and Muriate of Potash for Garden Crops.

The history of the plots where these two potash salts are under comparison has been outlined under section *A*. The crops are the same as those which have been named under that section. Each potash salt is used on three plots, *i.e.*, with each of the three nitrogen fertilizers. The results of the past year are shown in the following table : —

Sulfate and Muriate of Potash compared as Fertilizers for Garden Crops. — Yield per Plot (Pounds).

Average of Three Plots.	Onions.	Tomatoes.	Strawberries.	Celery.	Squashes.
Muriate of potash, ...	360	579.8	135.7	270	879.7
High-grade sulfate of potash, .	367	593.0	131.4	287	766.2

In the discussion of the relative standing of these two potash salts, the same crops are included respectively under the headings early and late as those specified in section *A*. The relative standing of these two salts at the beginning of the present year is shown in the following table: —

Fertilizers.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Sulfate of potash, ...	100.0	100.0
Muriate of potash, ...	92.6	103.0

Including the crops of the past year, the relative standing of the two potash salts is as follows: —

Fertilizers.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Sulfate of potash, ...	100.0	100.0
Muriate of potash, ...	93.2	102.9

Attention is called to the fact that the results of this year are in exact accord with those of earlier years. The sulfate of potash proves considerably superior to the muriate for the crops making most of their growth early in the season, while for those making their growth in the latter part of the season the muriate is slightly superior.

V. — Comparison of Different Potash Salts for Field Crops. (Field G.)

Since 1898 the following potash salts have been under comparison for various field crops: kainite, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate, and

silicate. Each is applied annually to the same plot, and all are used in such quantities as to furnish equal potash to each plot. All plots are equally manured with materials furnishing nitrogen and phosphoric acid. There are forty plots, in five series of eight plots each, each series including a no-potash plot and one for each potash salt used. The area per plot is about one-fortieth of an acre. The crops on this land last year were winter wheat on one series and ensilage corn on the other four series. On the series occupied by the winter wheat, clover was sown after reploughing, the last of July. On the four series occupied by corn last year clover was sown in the corn early in August. The clover on the series following wheat got an excellent start, and went through the winter well. The clover on the other series, owing to the dense shade of the corn, which was very heavy, made much less growth, and was to a considerable extent winter-killed. On these plots, Nos. 9 to 40, it was necessary to sow additional seed this spring. This was done on March 26, when the soil and weather conditions were favorable. The seed sown at this time started well. The usual fertilizers were applied this spring on April 25. The crop on all the plots was cut on June 11. That on the series which followed wheat was well grown, and the product of each plot was separately weighed. The product of the other plots was much mixed with weeds, which, on account of the winter-killing, were able to make considerable growth; and it was not considered that the weights would have much value, as indicating the relative yield of clover. Before the clover was cut, however, the plots were carefully examined. It was found that on each of the plots to which kainite had been applied the condition of the young clover was much inferior to that of the clover on the other plots. The color was poor, while many of the plants appeared to be dying. This difference was not apparent between the clover plants which had survived the winter on the different plots. Examination disclosed the further fact that there was a somewhat similar degree of inferiority in the condition of the young clover on all of the plots which had received an application either of the low-grade sulfate of potash or of muriate of potash, as compared with that on the other plots.

Indeed, at this time the young clover on all the kainite, low-grade sulfate and muriate of potash plots appeared to be inferior to that on the plots which had received no potash. By the middle of the season there were many places in all these plots on which there was no clover. Before the end of the season, however, such clover plants on these plots as survived became perfectly healthy, and were characterized by a marked degree of vigor. It cannot be doubted, in view of the unfavorable results which have been previously obtained in our experiments where muriate of potash has been used for clover, that it is the chlorides in the three fertilizers which cause the injury. Chlorides may produce this effect either because of the increased loss of lime which their use leads to, or possibly because of the fact that their continued use brings the soil into an acid condition. Either deficiency of lime or presence of free acid is known to be decidedly unfavorable to the growth of clover.

All the plots in the field were cut twice subsequent to June 11, viz., on August 4 and October 10. On the first date there was a moderate growth of small weeds and a few large ones on the plots on which the clover was poor, *i.e.*, on the kainite, muriate of potash, and low-grade sulfate of potash plots. These, as far as practicable, were thrown out. In estimating the significance of the differences in yield, however, it should be remembered that the real difference in the condition and growth of the clover was undoubtedly greater than the figures indicate, as where the clover is weakest the weeds are most numerous, and it is impossible to separate them all. The crops cut were carefully cured in cocks without loss of leaf, and the hay was well dried when weighed. The tables show the rates of yield per acre and the averages for the last two cuttings of the several potash salts: —

Clover. — Yield per Acre (Pounds).

Plots.	Potash Salt.	Hay.	First Cut, Rowen.	Second Cut, Rowen.	Totals.
1	No potash,	2,458	2,078	1,273	5,809
2	Kainite,	2,681	2,491	1,475	6,647
3	High-grade sulfate,	2,681	2,301	1,564	6,546

Clover. — Yield per Acre (Pounds) — Concluded.

Plots.	Potash Salt.	Hay.	First Cut, Rowen.	Second Cut, Rowen.	Totals.
4	Low-grade sulfate,	2,904	2,324	1,430	6,658
5	Muriate,	2,904	2,188	1,609	6,701
6	Nitrate,	3,128	2,156	1,475	6,759
7	Carbonate,	3,128	2,391	1,430	6,949
8	Silicate,	3,128	2,480	1,541	7,149
9	No potash,	–	2,100	1,273	3,373
10	Kainite,	–	1,966	849	2,815
11	High-grade sulfate,	–	2,569	1,296	3,865
12	Low-grade sulfate,	–	2,458	1,229	3,687
13	Muriate,	–	2,414	1,162	3,576
14	Nitrate,	–	2,670	1,162	3,832
15	Carbonate,	–	2,458	1,385	3,843
16	Silicate,	–	2,793	1,206	3,999
17	No potash,	–	2,435	670	3,105
18	Kainite,	–	2,145	581	2,726
19	High-grade sulfate,	–	2,636	983	3,619
20	Low-grade sulfate,	–	2,726	961	3,687
21	Muriate,	–	2,547	1,340	3,887
22	Nitrate,	–	2,815	1,251	4,066
23	Carbonate,	–	2,591	1,117	3,708
24	Silicate,	–	2,726	1,251	3,977
25	No potash,	–	2,234	626	2,860
26	Kainite,	–	2,324	849	3,173
27	High-grade sulfate,	–	2,815	1,206	4,021
28	Low-grade sulfate,	–	2,525	983	3,508
29	Muriate,	–	2,681	938	3,619
30	Nitrate,	–	2,748	1,117	3,865
31	Carbonate,	–	2,591	1,162	3,753
32	Silicate,	–	2,860	1,340	4,200
33	No potash,	–	2,435	849	3,284
34	Kainite,	–	2,100	760	2,860
35	High-grade sulfate,		2,703	1,251	3,954
36	Low-grade sulfate,	–	2,636	1,162	3,798
37	Muriate,	–	2,949	1,072	4,021
38	Nitrate,	–	2,681	1,117	3,798
39	Carbonate,	–	2,681	983	3,664
40	Silicate,	–	2,502	849	3,351

Clover Rowen. — Average Yield per Acre (Pounds).

Potash Salt.	First Cut, Rowen.	Second Cut, Rowen.
No potash (1, 9, 17, 25, 33),	2,256	938
Kainite (2, 10, 18, 26, 34),	2,205	903
High-grade sulfate (3, 11, 19, 27, 35),	2,605	1,260
Low-grade sulfate (4, 12, 20, 28, 36),	2,534	1,153
Muriate (5, 13, 21, 29, 37),	2,556	1,224
Nitrate (6, 14, 22, 30, 38),	2,614	1 224
Carbonate (7, 15, 23, 31, 39),	2,542	1,215
Silicate (8, 16, 24, 32, 40),	2,672	1,237

The figures call for little comment. They strikingly show the marked inferiority of the product on the plot receiving kainite. Not only is the average product on this plot lower than the yield on any of the other potash salts, — but it is lower in every series except one than the yield on the plot receiving no potash. The potash salt giving the highest average total yield is the silicate, — almost as good is the high-grade sulfate, — while the yield on the nitrate muriate and carbonate is not far behind.

VI. — Comparison of Phosphates on the Basis of Equal Application of Phosphoric Acid.

In this experiment, which has been in progress six years, we have under comparison the following phosphates: apatite, South Carolina rock phosphate, Florida soft phosphate, phosphatic slag, Tennessee phosphate, dissolved bone-black, raw bone, dissolved bone, steamed bone, and acid phosphate. The phosphates are all applied in the finely ground form, being carefully spread broadcast after ploughing in the spring, and harrowed in. Three plots in the field have received no phosphoric acid in any form since the beginning of the experiment. The plots are one-eighth of an acre each in area. The phosphates yearly applied are used in quantities sufficient to furnish actual phosphoric acid at the rate of 96 pounds to the acre. All plots are manured alike, with materials furnishing nitrogen and potash in available forms and in equal amounts to each. The materials regularly used furnish nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. During the past

year every plot in the field has received an extra application furnishing nitrogen during the growth of the crop. The material used was niterlime, a combination of nitrate of soda and quicklime, containing 10.44 per cent. nitrogen and 20.41 per cent. lime. This was applied broadcast on July 2, at the rate of 176 pounds per acre, and cultivated in.

The preceding crops have been: corn, cabbages, corn, and in 1900 oats for hay, and Hungarian grass also cut for hay, and onions. With the exception of the onions, all these crops have given large yields, even on the three plots in the field which have received no application of phosphoric acid. Attention is once more called to the fact that the soil of plot 1 seems to have been naturally in a much higher condition of fertility than that of any other plot in the field. In estimating the significance of the results, therefore, the yield of this plot should be disregarded. A more correct indication of the effect of each of the phosphates on plots 2 to 6 is afforded by comparing the yields of those plots with the yield on plot 7. It is, however, without doubt true that the soil from plot 7 towards plot 1 improves gradually in physical condition and natural fertility. The crop the present year has been onions. These throughout this part of the State have generally been a poor crop this year. Our yields are comparatively small even on the best plots. The results are given in the table: —

Onions on Plots with Equal Amounts of Phosphoric Acid.

Plots.	Fertilizer.	Onions (Bushels per Acre).	Scallions (Pounds per Acre).
1	No phosphate,	195.7	8,560
2	Apatite,	101.7	8,480
3	South Carolina rock phosphate,	121.8	9,360
4	Florida soft phosphate,	52.3	6,880
5	Phosphatic slag,	252.0	5,600
6	Tennessee phosphate,	44.6	6,960
7	No phosphate,	50.5	5,360
8	Dissolved bone-black,	173.8	5,640
9	Raw bone,	301.4	4,144
10	Dissolved bone meal,	388.9	5,400
11	Steamed bone meal,	243.8	5,840
12	Acid phosphate,	159.4	6,560
13	No phosphate,	26.2	6,600

Up to the time when onions were introduced as a crop on this field, the leading conclusions drawn from the experiments were the following: —

1. The phosphatic slag has apparently furnished phosphoric acid in an exceedingly available form, the yield on the plot receiving the slag being almost equal to that on the dissolved bone-black.

2. The Florida soft phosphate has given the lowest yields of any plot receiving phosphoric acid.

3. Steamed bone meal appears to be inferior in availability to raw bone meal.

For last year the phosphates giving the largest yields of sound onions, mentioned in the order of their rank, were: raw bone, phosphatic slag, South Carolina rock phosphate, apatite, dissolved bone meal, and dissolved bone-black. All others gave yields under 200 bushels to the acre.

Examination of the table shows that the results are in general similar to those of last year: the differences, however, are much greater and the apatite and South Carolina rock phosphate take a relatively much lower rank. The dissolved bone meal gives the largest crop; raw bone ranks next; while the phosphatic slag stands next in order, with steamed bone meal not far behind.

The proper ripening of the onion crop, as shown by this as well as other of our experiments, appears to be dependent in very large measure upon the presence of a liberal supply of highly available phosphoric acid. It appears very doubtful, therefore, whether it is likely ever to prove expedient to depend upon natural rock phosphates or untreated bone as a source of phosphoric acid for this crop.

VII. — Soil Tests.

During the past season we have conducted three soil tests, — two upon our own grounds, both in continuation of previous work upon the same fields, and one on the farm of A. M. Lyman of Montague. In these experiments the fertilizers are used in accordance with the co-operative plan for soil tests adopted in Washington in 1889. Each plot receives annually the same kinds of fertilizers, and

usually in the same amounts. These experiments are not calculated to secure the production of heavy crops, but are designed rather to throw light upon the general question as to how the different crops should be manured for the most profitable results. The fertilizers are so applied that it becomes possible to determine with much accuracy the effects of each of the leading elements of plant food. Every fertilizer used, whether applied by itself or in connection with one or both of the other fertilizer materials, is always applied in the same quantities. Fertilizers and manures are always applied broadcast after ploughing, and harrowed in. The following table shows the kinds and usual amounts per acre: —

Nitrate of soda, 160 pounds, furnishing nitrogen.
Dissolved bone-black, 320 pounds, furnishing phosphoric acid.
Muriate of potash, 160 pounds, furnishing potash.
Land plaster, 400 pounds.
Lime, 400 pounds.
Manure, 5 cords.

A. — Soil Test with Corn (South Acre), Amherst.

This acre has been used in soil tests for fourteen years, beginning in 1889. The crops in successive years have been as follows: corn, corn, oats, grass and clover, grass and clover, corn (followed by mustard as a catch crop), rye, soy beans, white mustard, corn, corn, grass and clover, grass and clover, and this year corn once more. Since 1889 this field has therefore borne six corn crops, and during this time it has been four years in grass.

It will be noticed that the crop last year was grass. The sod was turned on April 12. The land was thoroughly harrowed, twice before sowing the fertilizer and once after. The variety of corn was Sibley's Pride of the North. It was planted in drills, 3½ feet apart, on May 22. The season was cold and unfavorable to corn, but in spite of this fact the crop made very good growth upon the four plots to which potash has been yearly applied and upon the plot which has been yearly manured. Four of the plots in this field have received no manure nor fertilizer throughout the entire fourteen years, and these show a high degree of exhaustion, — indeed, these produced scarcely any sound

grain this year. The crop, however, is not yet sufficiently dried to shell; and calculation, allowing 90 pounds of ears, as weighed November 22, to a bushel, shows that the average apparent yield is at the rate of 9.7 bushels per acre. The actual yield of grain is believed to be under 4 bushels per acre. The table shows the manuring of the several plots, the rate of yield, and the gain or loss per acre compared with the nothing plots: —

Corn. — South Acre Soil Test, 1902.

Plots.	Fertilizer used.	Yield per Acre. Corn (Bushels, 90 Pounds).	Yield per Acre. Stover (Pounds).	Gain or Loss per Acre, compared with Nothing Plots. Corn (Bushels, 90 Pounds).	Gain or Loss per Acre, compared with Nothing Plots. Stover (Pounds).
1	Nitrate of soda,	7.3	1,180	—3.1	—300
2	Dissolved bone-black,	11.4	1,780	1.0	300
3	Nothing,	10.4	1,480	-	-
4	Muriate of potash,	47.7	4,760	37.3	3,507
5	Lime,	4.9	860	—5.5	—167
6	Nothing,	10.4	800	-	-
7	Manure,	68.7	6,220	58.3	5,420
8	Nitrate of soda and dissolved bone-black.	11.2	1,380	2.0	20
9	Nothing,	9.2	1,360	-	-
10	Nitrate of soda and muriate of potash.	53.4	3,540	44.3	2,200
11	Dissolved bone-black and muriate of potash.	55.9	4,640	47.0	3,320
12	Nothing,	8.8	1,300	-	-
13	Plaster,	14.6	1,880	5.8	580
14	Nitrate of soda, dissolved bone-black and muriate of potash.	56.2	4,540	47.4	3,240

The effect of each of the three elements of plant food — nitrogen, phosphoric acid and potash — is more clearly brought out in the tables which follow: —

	Results of the Addition of Nitrogen to — Nothing.	Phosphoric Acid.	Potash.	Phosphoric Acid and Potash.	Average Results.
Corn (bushels),	—3.1	1.0	7.0	.4	1.3
Stover (pounds),	—300	—280	—1,307	—80	—492

Value of decrease, ... $0 45
Financial result (loss), ... 3 65

	Results of the Addition of Phosphoric Acid to —				
	Nothing.	Nitrogen.	Potash.	Nitrogen and Potash.	Average Results.
Corn (bushels), . .	1.0	5.1	9.7	3.1	4.7
Stover (pounds), . .	300	320	—187	1,040	368

Value of increase, ... $3 74
Financial result (gain), ... 54

	Results of the Addition of Potash to —				
	Nothing.	Nitrogen.	Phosphoric Acid.	Nitrogen and Phosphoric Acid.	Average Results.
Corn (bushels), . .	37.3	47.4	46.0	45.4	44.0
Stover (pounds), . .	3,507	2,500	3,020	3,220	3,062

Value of increase, ... $34 06
Financial result (gain), ... 30 86

	Results of the Addition to Nothing of —			
	Lime.	Manure.	Plaster.	Complete Fertilizer.
Corn (bushels), ...	—5.5	58.3	5.8	47.4
Stover (pounds), ...	—167	5,420	580	3,240
Value of increment, ...	-	$48 53	$4 93	$36 54
Value decrease, ...	$3 72	-	-	-
Financial result, ...	$6 12 loss.	$23 53 gain.	$1 33 gain.	$26 94 gain.

The Effect of the Nitrogen. — It will be noticed that the employment of nitrate of soda alone (nitrogen) gives a crop which is actually less than that produced where no fertilizers are used. This variation is very likely accidental, as it can hardly be supposed that the nitrate is actually injurious. When used with potash alone, the nitrate gives a moderate increase in the crop. The average result is an increase of a little more than a bushel of grain, but a decrease of nearly 500 pounds in stover. The nitrate does not pay for itself, on either of the four plots to which it was applied; for the cost of the 160 pounds is $3.60, and on the only plot where the increase in grain is sufficient to

be worth this sum there is a decrease in the amount of stover, which brings the net increased value below the cost of the nitrate.

The Effect of the Phosphoric Acid. — Dissolved bone-black (phosphoric acid) used alone produced an insignificant increase. In the different combinations the results of its use indicate it to be moderately beneficial. The best result is secured where it is employed in connection with potash. The cost of the dissolved bone-black wherever employed was at the rate of about $3.20 per acre. The average increase in crop is sufficient to barely cover this amount. Particular attention is called to the splendid crop produced where dissolved bone-black and muriate of potash are used together. The combination of these two fertilizers without nitrogen apparently suffices, under the system of rotation which has been followed, to fully maintain the productiveness of this plot. Last year its yield was at the rate of 1,900 pounds of hay to the acre in the first crop and 1,500 pounds of rowen in the second crop. As was pointed out last year, this splendid product is undoubtedly due to the capacity which clover grown in mixture with the grasses possesses to draw the needed nitrogen from the air. The advantage obtained by this system of manuring is, however, not exhausted when we have taken the hay crops; for, as shown by the yield of corn this year of almost 56 bushels of sound grain to the acre, the corn crop which requires a large amount of nitrogen (which, so far as we know, must be taken from the soil), is able to derive the needed quantity of this element from the products of the decay of the clover roots and stubble. The expenditure for fertilizers applied to this plot has been at the rate of about $6.40 per acre, and for this sum we have this year nearly 56 bushels of corn and more than 2½ tons of stover. Moreover, the beneficial effects of this system of manuring appear to be cumulative. The productivity of this plot shows not the slightest signs of decrease after fourteen years, during which time neither manure nor fertilizer furnishing a single ounce of nitrogen has been applied. In view of the results upon other plots, it cannot be doubted that the increased yield on this plot is

due in very large measure to the potash employed, but the dissolved bone-black is also evidently useful.

The Effect of the Potash. — It will be noticed that wherever potash is applied, whether alone or in combination with either one or both of the other fertilizers, the result is a large yield. Potash is evidently the dominant plant food element on this soil for corn. The increase where this element is used alone is at the rate of more than 37 bushels to the acre; the average increase, at the rate of 44 bushels to the acre. The potash used costs at the rate of $3.20 per acre. This amount is covered many times over by the increase in the crop.

The Effect of the Manure. — The manure alone gives a large crop, — considerably larger than on any other plot. That this should be true is natural, in view of the fact that the manure at the rate at which it is applied furnishes a larger amount of plant food than is furnished in the fertilizers. It also tends to keep up the supply of humus in the soil, and this, as is well understood, is highly beneficial in many ways. The yearly cost of the manure applied is, however, at the rate of about $25 per acre, while the complete fertilizer used on plot 14 costs only $10.

The results with corn this year are entirely similar in kind to those which have been obtained in the earlier years in which corn has been grown on this piece of land. They show very conclusively that on such land corn can be cheaply grown by the use of fertilizers alone, and they demonstrate conclusively that potash should be a very prominent constituent. In view of the fact that the fertilizers generally used by the farmers of the State for corn usually contain far more phosphoric acid than potash, these results appear to be well worth attention. The important question naturally at once arises, "How far are the requirements of the corn crop on the farms in other parts of the State similar to those shown by these experiments?" In answer to this question, attention is called to the results of similar experiments in various parts of the State, which have been published in Bulletins Nos. 9 and 14 of this station. These results indicate that in most localities the potash in fertilizers appears

to have a greater effect in increasing the corn crop than either of the other prominent elements. Especially has this been found to be the case on the better soils of the State. The results upon light and poor soils in Yarmouth, Freetown and Marblehead have shown but small increase for any of the fertilizers used. On such soils farmyard manures prove much the most effective. On the soils with good physical characteristics, *i.e.*, soils on which crops are not likely to suffer excessively in hot, dry weather, and especially if the soil is one which is in a fair state of fertility, the increase due to potash has always been found to be striking, and it is believed that farmers should see to it that this element is more largely supplied to this crop.

B. — Soil Test with Potatoes (North Acre).

The field on which this test was carried out has been used in similar tests with various crops for thirteen years, beginning in 1890. The crops grown in order of succession include potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and rutabaga turnips, potatoes, and onions, for four years (1898 to 1901 inclusive).

Rye was sown a short time before the onion crop of last year was pulled, in the hope of producing a crop which would serve as winter cover, and to prevent washing, to which this field is liable. This object was only in part accomplished, as the rye sown on the surface did not make a perfect start. There was considerable washing, as a result of heavy storms in March. It is not believed, however, that this was of such a character as seriously to interfere with the accuracy of our fertilizer tests, for it was for the most part with and not across plots. The several plots in this field have been manured in accordance with the usual soil test plan, with the exception that double quantities of all fertilizer materials were used during the years when onions have been grown, as well as this year. In one other respect the treatment of this field has been peculiar. The lower half of all plots received an application of lime in the spring of 1898 at the rate of 1 ton to the acre. The nitrate used during the present season was put on in two applica-

tions, — one-half applied broadcast just before planting the seed, the other half scattered about the plants and cultivated in on June 30, at which time the crop was about half grown. The field was ploughed on May 7, at which time the rye had made considerable growth. There were marked differences on the different plots, but no clearly defined difference beween the limed and unlimed portions of the several plots. The fertilizers in double the usual amounts were spread broadcast on May 12 and immediately harrowed in. The variety of potatoes planted was the Delaware, the seed being grown in the adjoining town of Hadley. In preparation for planting the seed was soaked in a solution of corrosive sublimate, for the prevention of scab. It was then dried, and the tubers were cut into pieces with two good eyes each, and planted at once. The date of planting was May 13. The potatoes started well, the crop was thoroughly cared for, and there were no accidental conditions recognized as interfering with the normal development of any of the plots. The potatoes were sprayed twice, — on July 11 with Bowker's Boxal, and on July 26 with Bowker's Bodo, to which a suitable quantity of Paris green for destruction of bugs was added. Both sprayings were effective in destroying bugs but not fully effective in preventing blight, which, however, was not serious on this field, where the growth of the tops was comparatively light. There was no rot whatever, although this disease was prevalent on similar soils in the immediate neighborhood. The crop was dug on September 8 and 9. All tubers were smooth, but of rather small average size; they were, however, of excellent quality. The following tables show the fertilizers applied to the several plots, the yields per acre, and the gain or loss compared with the nothing plots: —

Potatoes. — North Acre Soil Test (Unlimed), 1902.

Plots.	Fertilizers used.	Yield per Acre (Bushels).		Gain or Loss per Acre compared with Nothing Plots (Bushels).	
		Merchantable.	Small.	Merchantable.	Small.
1	Nothing,	27.7	24.0	-	-
2	Nitrate of soda,	30.0	20.7	1.1	—2.9
3	Dissolved bone-black,	39.3	20.0	9.2	—3.1
4	Nothing,	31.3	22.7	-	-
5	Muriate of potash,	58.0	15.3	25.7	—9.1
6	Nitrate of soda and dissolved bone-black.	69.3	28.7	36.0	2.7
7	Nitrate of soda and muriate of potash.	51.3	26.0	17.0	—1.7
8	Nothing,	35.3	29.3	-	-
9	Dissolved bone-black and muriate of potash.	73.7	18.0	41.1	—9.4
10	Nitrate of soda, dissolved bone-black and muriate of potash.	110.3	17.0	80.4	—8.5
11	Plaster,	24.7	16.0	—2.5	—7.6
12	Nothing,	24.5	21.7	-	-

Potatoes. — North Acre Soil Test (Limed), 1902.

Plots.	Fertilizers used.	Yield per Acre (Bushels).		Gain or Loss per Acre compared with Nothing Plots (Bushels).	
		Merchantable.	Small.	Merchantable.	Small.
1	Nothing,	21.3	27.7	-	-
2	Nitrate of soda,	27.3	20.3	5.5	—5.3
3	Dissolved bone-black,	26.0	22.0	2.2	—1.4
4	Nothing,	22.7	21.3	-	-
5	Muriate of potash,	69.0	12.7	43.8	—8.6
6	Nitrate of soda and dissolved bone-black.	71.3	29.0	43.6	7.7
7	Nitrate of soda and muriate of potash.	58.3	17.3	28.1	—4.0
8	Nothing,	32.7	21.3	-	-
9	Dissolved bone-black and muriate of potash.	93.7	20.0	61.6	—.3
10	Nitrate of soda, dissolved bone-black and muriate of potash.	115.3	17.3	83.8	2.0
11	Plaster,	24.3	13.7	—6.6	—4.6
12	Nothing,	30.3	17.3	-	-

Potatoes (Bushels per Acre).	Results of the Addition of Nitrogen to—				
	Nothing.	Phosphoric Acid.	Potash.	Phosphoric Acid and Potash.	Average Results.
Unlimed:—					
Merchantable, . .	1.1	26.8	—8.7	39.3	14.6
Small, ...	—2.9	5.8	7.4	.9	2.8
Limed:—					
Merchantable, . .	5.5	39.8	—15.7	22.2	13.0
Small, ...	—5.3	9.1	4.6	2.3	2.7

Value of increase, unlimed, ...	$9 32
Financial result, unlimed (gain), ...	2 92
Value of increase, limed, ...	8 34
Financial result, limed (gain), ...	1 94

Potatoes (Bushels per Acre).	Results of the Addition of Phosphoric Acid to—				
	Nothing.	Nitrogen.	Potash.	Nitrogen and Potash.	Average Results.
Unlimed:—					
Merchantable, . .	9.2	34.9	15.4	63.4	30.7
Small, ...	—3.1	5.6	—.3	—6.8	—1.2
Limed:—					
Merchantable, . .	3.8	38.1	17.8	55.7	28.9
Small, ...	—1.4	13.0	8.3	6.0	6.5

Value of increase, unlimed, ...	$18 18
Financial result, unlimed (gain), ...	11 78
Value of increase, limed, ...	18 64
Financial result, limed (gain), ...	12 24

Potatoes (Bushels per Acre).	Results of the Addition of Potash to—				
	Nothing.	Nitrogen.	Phosphoric Acid.	Nitrogen and Phosphoric Acid.	Average Results.
Unlimed:—					
Merchantable, . .	25.7	15.9	31.9	44.4	29.5
Small, ...	—9.1	1.2	—6.3	—11.2	—6.4
Limed:—					
Merchantable, . .	43.8	22.6	57.8	40.2	41.1
Small, ...	—8.6	1.3	1.1	—5.7	—3.0

Value of increase, unlimed, ...	$16 42
Financial result, unlimed (gain), ...	10 02
Value of increase, limed, ...	24 06
Financial result, limed (gain), ...	17 66

Potatoes (Bushels per Acre).	Results of the Addition to Nothing of — Complete Fertilizer.	Plaster.
Unlimed: —		
Merchantable,	80.4	—2.5
Small,	—8.5	—7.6
Limed: —		
Merchantable,	83.8	—6.6
Small,	2.0	—4.6
Value of increase, unlimed,	$46.64	-
Value of decrease, unlimed,	-	$3.02
Financial result, unlimed,	27.44 gain	6.62 loss
Value of increase, limed,	50.68	-
Value of decrease, limed,	-	4.88
Financial result, limed,	31.48 gain	8.48 loss

It will be noticed that no plot in the field has produced what is regarded as a good crop. This field has now been tilled for several years without the introduction of a grass crop, and the stock of humus in the soil must be exceedingly small. It is believed that this deficiency in humus, on the presence of which, in moderate quantity, potatoes are known to be quite dependent, accounts in a measure for the relatively low yield on the plot to which a complete fertilizer was applied. It will be noticed, further, that there is not a very wide difference between the yields of the unlimed and limed portions of the several plots. With onions as a crop the difference is very large on all plots to which muriate of potash, nitrate of soda, or both of these fertilizers without dissolved bone-black are applied. The fact that potatoes show a far smaller difference may be due to either of two causes: first, that this crop is less sensitive to a deficiency of lime than onions; or, second, that the effects of the lime applied in 1898 are now largely exhausted. We have some evidence that this effect is so exhausted. The soil on the limed portion of the plots manured with muriate of potash or nitrate of soda, as shown by chemical tests, appears to be once more acid.

The Effect of the Nitrogen. — It will be remembered that nitrate of soda was applied to the four plots receiving this fertilizer in double the usual quantities, viz., at the rate of 320 pounds per acre. It increases the crop to a considerable extent only where it is used in connection with dissolved bone-black. Used in connection with this fertilizer, it gives an increase sufficient, with potatoes at 60 cents per bushel, to much more than cover the cost. The fact that it does not give an increase when used in connection with potash (which as will be seen later was the most useful of the fertilizer elements) is strongly indicative of the fact that the soil on the plot receiving nitrate and muriate of potash is once more acid, even on the part limed in 1898. A study of the results leads to the conviction that the experiment furnishes but an imperfect test as regards the necessity of an application of nitrogen on account of the poor physical and chemical condition of the soil, due to deficiency both of humus and lime.

The Effect of the Phosphoric Acid. — The dissolved bone-black (furnishing phosphoric acid), when used in connection with either or with both of the other fertilizers, gives an increase more than sufficient to cover its cost. It gives the largest increase in connection with both of the other fertilizers, which indicates a high degree of general exhaustion. It gives the smallest increase when used in connection with muriate of potash, which is still further evidence of the probable deficiency of lime, for such deficiency is known to be most marked where muriate of potash is largely employed as a fertilizer.

The Effect of the Potash. — The increase in crop produced by the application of muriate of potash where it is used alone or with either or both of the other fertilizers is in all cases much more than sufficient to cover the cost of the fertilizer. The increase on the limed half of the plots is without exception, if small and large tubers both be included, considerably greater than on the unlimed portion of the plots; indicating that, although there may be a present deficiency in the amount of lime necessary for the best results, the effects are not yet wholly exhausted. In practically all

soil tests which have been carried out by this station, whether on this farm or on farms in other parts of the State, the potato crop has always shown a marked dependence upon a liberal supply of potash, which we may safely say, therefore, should be more prominent than it usually is in the special fertilizers made for this crop. It seems worth while to call attention here to the fact that, for the sake of uniformity in soil test-work, the potash salt here employed was the muriate. It will be remembered that it has been shown as a result of numerous experiments here that the sulfate is preferable, giving better results, as indicated both by yield and quality.

VIII. — Manure Alone *v.* Manure and Potash.

This experiment was begun in 1890, and is intended to illustrate the relative value in crop production of an average application of manure, as compared with a smaller application of manure in connection with a potash salt. Full accounts will be found in the preceding annual reports, and summaries in the reports for 1895 and 1900. The field is level, and the soil of apparently even quality. It is divided into four quarter-acre plots. The crop for the years 1890 to 1896 was corn; for the years 1897 and 1898, mixed grass and clover; for the years 1899 and 1900, corn; for the past two years, mixed grass and clover. The present is therefore the second year that the land has been continuously in grass. Plots 1 and 3 received an application of manure at the rate of 6 cords per acre; plots 2 and 4, manure at the rate of 4 cords per acre, and high-grade sulfate of potash at the rate of 160 pounds per acre. The annual cost of the manure as applied to plots 1 and 3 is estimated to be at the rate of $30 per acre. The annual cost of the manure and the potash salt applied to plots 2 and 4 at the same price per cord for the manure is at the rate of $23.60 per acre. The yields for the present season are shown in the table: —

Yields of Hay and Rowen (Pounds).

Plots.	Hay.	Rowen.
Plot 1,	955	740
Plot 2,	915	690
Plot 3,	1,010	780
Plot 4,	900	680

The rates of yield per acre are shown below: —

Yield of Hay and Rowen per Acre (Pounds).

Plots.	Hay.	Rowen.	Total.
Plot 1,	3,820	2,860	6,680
Plot 2,	3,660	2,760	6,420
Plot 3,	4,040	3,120	7,160
Plot 4,	3,600	2,720	6,320

Averaging the yields for plots 1 and 3, we find the total to be at the rate of 6,920 pounds per acre. A similar average for plots 2 and 4 gives a yield at the rate of 6,370 pounds per acre. The larger application of manure therefore gives a yield at the rate of 450 pounds per acre more than the smaller application of manure and the potash. The difference in cost of the two applications, as shown above, is at the rate of $6.40 per acre. The 450 pounds of hay costs, therefore, this amount standing in the field. Grass standing in the field cannot be considered to be worth in an average season more than about $7 or $8 per ton of well-made hay. Although, therefore, we have a small difference in favor of the larger application of manure in total crop, the financial outcome is clearly in favor of the combination of the lesser amount of manure and the potash salt.

We have now grown on this field under substantially the present system of manuring nine corn crops and four hay crops, and the results may be briefly stated as follows: —

1. The corn crops under the two systems of manuring have been practically equal in value.

2. The hay crops have been slightly larger on the plots receiving the more liberal application of manure alone; but these increases have been produced at a cost, where manure is estimated at $5 per cord in the field, which is greater than their value.

IX. — Special Corn Fertilizer *v.* Fertilizer Richer in Potash.

This field has been used continuously in experiments designed to throw light upon the question of the proper use of fertilizers for the corn crop since 1891. From that year to 1896 inclusive the crop was corn; in 1897 and 1898 the crop was mixed grass and clover; in 1899 and 1900, it was corn; and for the past two years, it has been grass and clover. A full account of results to date will be found in preceding annual reports. The especial object in view is to test the question as to whether the special corn fertilizers offered in our markets are of such composition as is best suited for the production of corn in rotation with mixed mowing. The field is divided into four quarter-acre plots, and throughout the entire period during which the experiment has continued two of these plots (1 and 3) have yearly received an application of mixed fertilizers, furnishing the same amounts of nitrogen, phosphoric acid and potash as would be furnished by 1,800 pounds of fertilizer of the composition of the average of the special corn fertilizers analyzed at this station. This average in 1899, since which date there has been no change in the kinds and amounts of fertilizers used, was as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The fertilizers analyzed varied widely in composition, the range for each of the elements being shown by the following: —

	Per Cent.
Nitrogen,	1.5– 3.7
Phosphoric acid,	9.0–13.0
Potash,	1.5– 9.5

The other two plots (2 and 4) have annually received an application of materials substantially the same in kind and quantity as those recommended in Bulletin No. 58 for corn on soils poor in organic matter. The essential difference between the applications on the two pairs of plots is that 2 and 4 receive materials furnishing a much larger quantity of potash and much less phosphoric acid than the other pair of plots. The fertilizers applied to the several plots are shown below: —

Fertilizers used.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	–
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Sulfate of potash,	37.5	62.5

The present is the second season that this field has now been in grass. The past season has been favorable to the hay crop, the field was cut twice, and the hay was weighed and housed in excellent condition. The tables show the yields: —

Yields of Hay and Rowen, 1902 (Pounds).

Plots.	Hay.	Rowen.	Total.
Plot 1 (lesser potash),	3,712	1,540	5,252
Plot 2 (richer in potash),	5,072	1,900	6,972
Plot 3 (lesser potash),	3,992	1,260	5,252
Plot 4 (richer in potash),	5,012	1,560	6,572

Averaging the two pairs of plots, we have the rates of yield per acre for hay, rowen and total shown below: —

Average Yield per Acre (Pounds).

Plots.	Hay.	Rowen.	Total.
Plots 1 and 3,	3,852	1,400	5,252
Plots 2 and 4,	5,042	1,730	6,772

It will be noticed that the yields both of hay and rowen were considerably heavier on plots 2 and 4 (*i.e.*, the plots which received fertilizers richer in potash) than on the other pair of plots. The proportion of clover was much the larger on plots 2 and 4; and, as clover is superior in nutritive value to grass, it is evident that the superiority of the crop was even greater than the weight difference in yield in itself indicates. The cost of the fertilizers applied to plots 1 and 3 exceeds that of the fertilizers applied to plots 2 and 4 at the rate of about $4 per acre. We have, then, as a result of this experiment for this year, 6,772 pounds of hay of superior nutritive value, produced at a cost of $4 less than the 5,252 pounds produced by the other pair of plots. This result is in exact accordance with the teachings of the soil test on the south acre. There can be no doubt that potash should be more abundant in fertilizers for corn than is usually the case. It is important to point out the further fact that the difference between the two pairs of plots, as indicated by the greater productivity of the plots receiving the heavier application of potash, seems to be increasing from year to year. The results of this experiment to date may be briefly stated as follows: —

1. The crops of corn thus far have been substantially equal under the two systems of manuring.

2. The crops of hay have always been larger on the plots where more potash has been used, and the nutritive value pound for pound has been greater on account of the larger proportion of clover.

In conclusion, I may quote from my report for last year: —

In view of the fact that the clover sod when turned is exceedingly favorable for succeeding crops, it is confidently anticipated

that the differences in yields under the two systems of manuring will increase from year to year, and that the superiority of the mixture of fertilizers containing more potash will therefore become increasingly evident.

X. — Experiment in manuring Grass Lands.

In this experiment, which has continued since 1893 upon one uniform system, our object is to test the value for production of grass of the system of using wood ashes, ground bone and muriate of potash, and manure, in rotation. Owing, however, to the fact that the land has been for many years in grass, and that it has never been cultivated consecutively for a sufficiently great length of time to free it from weeds, the sod had become considerably infested with daisies, ragged robin, buttercups, and a number of other species. It has accordingly been decided to break up and reseed a part of the land. A portion has been cultivated for two years, and is now reseeded. This portion constitutes a part of plot 3. This year, after the harvest of the first crop, which was cut early to avoid ripe weed seeds, a portion each of plots 1 and 2 was broken up. This was frequently harrowed between the date of ploughing, which was about the middle of July, and the date of seeding, which was August 15. The portion of plot 3 not previously broken up has been similarly treated. The area reported upon this year, therefore, comprises only a portion of the plots included in this field, the total area of which is about nine acres.

The rates at which the several manures are employed are as follows: wood ashes, 1 ton per acre; ground bone, 600 pounds, and muriate of potash, 200 pounds, per acre; manure, 8 tons per acre.

The plot which receives wood ashes one year is the next year manured with bone and potash, and the third year with manure.

The manuring of the several plots is so planned that each year we have one plot under each of the systems of manuring. For the last three years the plots receiving respectively wood ashes and bone and potash have also received

nitrate of soda at the rate of 150 pounds per acre. The manure is always applied in the fall; the ashes, and the bone and potash and the nitrate of soda, in early spring.

The past season has been in general favorable to the hay crop, but our yields on this field are lower than usual, chiefly, it is believed, on account of the fact that both the first and second cuttings were made earlier than usual, which, as has been stated, was for the purpose of avoiding ripe weed seeds. The yields of hay, and of rowen, where any was cut, and the totals for each system of manuring, were as follows: —

Fertilizers used.	Hay (Pounds).	Rowen (Pounds).	Total (Pounds).
On barnyard manure,	2,396	1,805	4,201
On bone and potash and nitrate of soda,	2,661	1,242	3,903
On wood ashes and nitrate of soda,	3,723	–	3,723

The average yield of the entire area for this year is 3,942 pounds; the average for the period 1893 to the beginning of the present year was 6,619 pounds; the average to date, 6,413 pounds. The plots when dressed with manure have averaged 6,655 pounds; when dressed with bone and potash, 6,420 pounds; and when dressed with wood ashes, 6,094 pounds. The average yields for this year, as will be seen, are materially below the general averages. As has been stated, this is undoubtedly accounted for chiefly by the difference in the time of cutting. The average even for this year constitutes a very satisfactory crop, and for the entire period is such as to render the hay crop, at the prices which the manures used cost, a decidedly profitable one.

XI. — Experiment in the Application of Manure.

The experiment now to be reported is in continuation of work begun in 1899. It has for its object to determine whether it is better to spread fresh manure during late fall and winter, allowing it to remain upon the surface until spring, or to put the manure when hauled out into large

heaps, to be spread just before ploughing the land in the spring. A full account of the plan of the experiment will be found in the last annual report. The field contains five plots, one-half of each having the manure spread in winter, the other half put into a large heap and spread in spring. We have, in reality, then, five parallel experiments yearly. In 1901 this field produced a crop of Japanese barnyard millet. After the millet was harvested, the field was ploughed and sown to winter rye, which served as a cover crop. During the past season the field has been in corn for the silo. The soil is naturally cold, and with the cool summer it produced but a small yield. The actual and relative yields of the several plots of rather more than one-fourth acre each are shown in the following table: —

Actual and Relative Yields of Ensilage Corn.

Plots.	Manuring Previous to 1899.	Actual Yields (Pounds).		Relative Yields (Per Cent.).	
		North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
1	Barnyard manure,	5,275	5,480	100	103.9
2	Wood ashes,	4,780	4,650	100	97.3
3	No manure,	2,600	3,900	100	150.0
4	Fine-ground bone and muriate of potash.	4,480	4,105	100	91.6
5	Fine-ground bone and sulfate of potash.	4,905	5,325	100	108.6

In previous years the south half (spring manured) of each plot has without exception given a much superior yield to the north half. This year there are two exceptions: plot 2, where the difference, however, is very small; and plot 4, where there is a difference of 375 pounds in favor of the north or winter-manured half. It must be stated, however, that, owing to unavoidable conditions, one load of the corn on the south half of plot 4 lay upon the ground as it was cut from Saturday night until Monday. There can be no doubt that there was a considerable loss of weight, due to drying. We must not, therefore, attach any special

significance to the results upon this plot. The results upon the others are practically confirmatory of the results of previous years. The differences, however, are considerably less. In 1900, the yield of the winter-manured portion of each plot being considered as 100, the yields of the spring-manured portion of the plots varied from 103 to 125. In 1901 the relative yields of the spring-manured plots, on the same basis, varied from 118 to 177. The smaller differences this year are believed to be in part at least a consequence of the fact that the conditions prevailing during the winter of 1901 and 1902 were such that there was much less washing over the surface of the plots, which, it will be remembered, slope lengthwise, than during the two preceding winters. The smaller differences may also be in part due to the unfavorable effects of the season, which prevented entirely normal development on any part of the field. It is believed that our experiments indicate decisively the necessity of greater care than is always taken to avoid spreading manures on slopes during late fall and winter. Our differences in yield this year are not, it is true, sufficiently great to pay for the extra cost of rehandling the manure, which is first piled in the field. During the two past years the differences in crops have been much more than sufficient to pay this extra cost. The experiment will be continued.

XII. — Nitrate of Soda for Rowen.

The present is the third year during which we have conducted experiments for the purpose of determining whether an application of nitrate of soda after the harvest of the first crop of hay will give a profitable increase in the rowen crop. The results for the two preceding years have with one exception on a timothy sod shown an increase more than sufficient to cover the cost of the nitrate and its application. The experiments of this year were carried out upon a timothy sod which was seeded in 1899. This mowing was top-dressed this spring as follows: —

	Pounds per Acre.
Nitrate of soda,	150
Fine-ground bone,	400
Muriate of potash,	200

The product at the first cutting was at the rate of 5,640 pounds of hay per acre.

Eight equal plots were laid out, and on the alternate plots nitrate of soda was applied, — to two at the rate of 150 pounds to the acre, to one at the rate of 200 pounds, and to another at the rate of 250 pounds. The first crop of timothy was cut on July 11 and 14. The nitrate was applied on July 22. The rowen was cut on September 22 and weighed on October 3, in good condition. The rates of yield per acre are shown in the following table: —

Plots.	Fertilizers used.	Pounds.
Plot 1,	No nitrate,	459
Plot 2,	Nitrate of soda, 150 pounds,	826
Plot 3,	No nitrate,	367
Plot 4,	Nitrate of soda, 150 pounds,	789
Plot 5,	No nitrate,	257
Plot 6,	Nitrate of soda, 200 pounds,	1,320
Plot 7,	No nitrate,	587
Plot 8,	Nitrate of soda, 250 pounds,	1,542

The average results were as follows: —

	Pounds.
Average no-nitrate plots,	417.5
Average increase due to application of 150 pounds of nitrate,	390.0
Increase due to application of 200 pounds of nitrate,	902.5
Increase due to application of 250 pounds of nitrate,	1,124.5

The moisture conditions on the different plots of this field, which is of considerable length, are not exactly uniform, being somewhat more favorable toward that end of the field on which the larger applications of nitrate of soda were made. It is believed that this difference in moisture conditions in part accounts for the better apparent effect of the nitrate where applied in the larger quantities. If we determine the increases apparently due to the nitrate by comparison of the yields on plots to which such application

was made with the nearest nothing plots only, the apparent effect is as follows: —

	Pounds.
Average increase due to application of 150 pounds of nitrate,	446.5
Increase due to application of 200 pounds of nitrate, . .	898.0
Increase due to application of 250 pounds of nitrate, . .	955.0

All these increases are more than sufficient to cover the cost of the application of nitrate made.

XIII. — Variety Test, Potatoes.

During the past year we have grown, under conditions allowing a fair opportunity for comparison, thirty-three varieties of potatoes. The seed of all varieties was the first generation of our own growing. We included for purposes of comparison an equal area of one of the standard varieties, — Beauty of Hebron, — with seed of the second generation, from northern Maine. We raise our own seed, because it is recognized that the locality in which seed stock is produced and the way in which it is stored and handled has much to do with its productive capacity. We cultivate all varieties of potatoes that we test, therefore, two years, the first year being the preliminary test, made with small quantities of seed gathered from the many different sources from which a list of varieties must be made up. It is the product of this first crop that we use a second year in a final test, the seed of all varieties being stored and handled in precisely the same way. It is the results of this second year's test which are here reported.

The seed tubers planted this year were selected to as nearly as possible an average size of 60 grams in weight for each variety. The tubers were treated with corrosive sublimate in the ordinary way on April 9, and were spread in a light and sunny room in a single layer until May 14, when they were planted, being first cut to pieces of two good eyes each. The pieces were planted 1 foot apart in rows 3 feet apart. The field is one which has been used for a number of years in experiments with corn, in growing which a moderate application of fertilizers alone has been made.

The soil is a medium loam underlaid by gravel, and with perfect natural drainage, — a good potato soil. It received this year an application of manure from milch cows at the rate of 4 cords per acre. A fertilizer mixture was made, containing: —

	Pounds.
Nitrate of soda,	80
Dried blood,	100
Dry ground fish,	180
Acid phosphate,	280
High-grade sulfate of potash,	160

This mixture was used in the drill, being scattered widely the full length of the open furrow at the rate of 1,600 pounds per acre. The crop was thoroughly cared for, and sprayed three times with a combined insecticide and fungicide. This application did not prove altogether effective, although there was no rot. Growth was normal, and no signs of blight appeared until early in August. The varieties on which it showed itself previous to August 10 were: All the Year Round, Daughter of Early Rose, Early Carmen, Early Trumbull, Early Eureka, Early Rose, Early Pioneer, Ensign Bagley, Ford 1902, Harvest King, Honoeye Rose Seedling, Northern Beauty, New England Thoroughbred, Sunlight, and Smith's Six Weeks. Those on which it showed itself later than August 20, and which therefore may fairly be considered unusually disease-resistant, were: Livingston, Million Dollar, Mark Hanna, and Smith's '99.

The table shows the dates at which the vines of the several varieties were completely dead, and the rates of yield per acre for each: —

Variety.	Vines Dead.	Merchantable (Bushels).	Small (Bushels).
All the Rear Round,	Aug. 5,	165.9	41.5
Arcadia,	Aug. 30,	235.4	12.5
Beauty of Hebron (first generation from Maine seed).	Aug. 30,	315.3	16.6
Beauty of Hebron (second generation from Maine seed).	Aug. 30,	298.7	24.9
Daughter of Early Rose,	Aug. 30,	256.2	35.3
Early Carmen,	Aug. 16,	170.0	23.9

Variety.	Vines Dead.	Merchantable (Bushels).	Small (Bushels).
Early Trumbull,	Aug. 20, .	242.7	28.0
Early Eureka,	Aug. 20, .	232.3	27.0
Early Rose,	Aug. 25, .	258.2	36.3
Early Pioneer,	Aug. 20, .	185.7	27.0
Early Nancy,	Aug. 30, .	273.8	35.3
Ensign Bagley,	Aug. 25, .	262.4	50.8
Ford 1902,	Aug. 25, .	73.5	13.0
Gem of Aroostook,	–	258.2	51.8
Harvest King,	Aug. 30, .	218.9	20.8
Hammond's Wonderful,	Aug. 5, .	224.0	22.8
Honoeye Rose Seedling,	Aug. 25, .	177.4	31.1
I. X. L.,	Aug. 30, .	298.7	53.9
Livingston,	Aug. 30, .	161.8	37.3
Million Dollar,	Aug. 30, .	265.5	9.3
Mark Hanna,	Aug. 30, .	210.5	10.4
Northern Beauty,	Aug. 30, .	245.8	47.7
New England Thoroughbred,	Aug. 30, .	232.3	60.2
Rough Rider,	Aug. 30, .	211.5	43.6
Rose of the North,	Aug. 30, .	239.5	41.5
Stevens,	Aug. 25, .	148.3	38.4
Steuben,	Aug. 30, .	297.7	35.3
Sunlight,	Aug. 25, .	224.0	49.8
Smith's Six Weeks,	Aug. 30, .	65.3	36.3
Smith's '99,	–	203.3	31.1
The June,	–	77.8	19.7
Twentieth Century,	Aug. 20, .	214.7	42.5
White Giant,	Aug. 20, .	230.3	8.3

Among these varieties it will be seen that ten give a yield at the rate of over 250 bushels of merchantable tubers per acre. These, mentioned in the order of productiveness, are as follows: Beauty of Hebron (first generation from Maine seed), 315.3 bushels; Beauty of Hebron (second generation from Maine seed), 298.7 bushels; I. X. L., 298.7 bushels; Steuben, 297.7 bushels; Early Nancy, 273.8 bushels; Million Dollar, 265.5 bushels; Ensign Bagley, 262.4 bushels; Early Rose, 258.2 bushels; Gem of Aroostook, 258.2 bushels; Daughter of Early Rose, 256.2 bushels.

Six varieties, as will be seen, gave yields at the rate of between 100 and 200 bushels per acre. These, mentioned in the order of least productiveness, are the following: Stevens, 148.3 bushels; Livingston, 161.8 bushels; All the Year Round, 165.9 bushels; Early Carmen, 170 bushels; Honoeye Rose Seedling, 177.4 bushels; Early Pioneer, 185.7 bushels. Three varieties have given yields at the rate of under 100 bushels merchantable tubers per acre, viz.: Smith's Six Weeks, 65.3 bushels; Ford, 73.5 bushels; The June, 77.8 bushels. The last three varieties would seem beyond a doubt to be very inferior in productive capacity, and probably not worth cultivation. The varieties giving yields at the rate of between 100 and 200 bushels to the acre are, with one exception, well above 150 bushels; and, although giving much below the average yield for this season, they cannot be unreservedly condemned for lack of productiveness.

It may be remembered that in every test of varieties which has been made by this department of the Hatch Experiment Station the Beauty of Hebron and the Early Rose have been included. They have always ranked high in productiveness. This year it will be noticed that the Beauty of Hebron (first generation from Maine-grown seed) stands at the head, that the second generation from Maine-grown seed is next (although equalled by one other variety), and that the Early Rose is only seventh in the list. These facts constitute a striking commentary upon the claims which are usually made for new varieties. It is firmly believed that it is much wiser that potato growers shall secure seed of standard varieties grown and stored under the best conditions, than to pay high prices for new varieties, which in so many instances when carefully tested under the fairest possible conditions are found not to equal the older sorts either in productiveness or in quality. In our experience seed grown in northern Maine has invariably been found to be superior to that of our own production, even in the first generation. The Maine seed gives the larger yield, and the crop is somewhat earlier. It usually costs somewhat

more than home-grown seed, but it is richly worth the greater price.

XIV. — Poultry Experiments.

In our experiments with poultry during the past year we have confined our attention almost exclusively to questions connected with the feeding of fowls for eggs. The principal question upon which we are striving to obtain light relates to the proper relation between the different nutrients in the ration fed; or, in other words, it is a question of the best nutritive ratio. During the past year our work has been as follows: —

1. We have compared two rations in one of which corn is prominent, in the other wheat, using beef scraps as the source of animal food, the nutritive ratios being: for the ration including corn, from 1 : 4.25 — 4.74; and in the ration in which wheat is prominent, 1 : 6.25 — 6.45.

2. We have compared two rations in which respectively corn and wheat are prominent, with milk albumin as the source of animal food. The nutritive ratio of the ration including wheat has been varied from 1 : 4 — 4.48; for the ration including corn, from 1 : 4.95 — 6.05.

3. We have compared two rations in one of which buckwheat is prominent, in the other corn, with milk albumin as the source of animal food. The nutritive ratio of both these rations has been rather wide, — from about 1 : 5.5 — 6.08.

The most important points to be noted in connection with the results are as follows: —

1. In the comparison of wheat with corn, where beef scraps are the source of animal food, the egg production has been good and nearly equal on the two rations, although the hens receiving the wheat ration have been somewhat the most productive.

2. In the comparison of wheat with corn, with milk albumin as the source of animal food, the egg production has been less satisfactory, and the hens which have received the corn ration have been the more productive.

3. In the comparison of buckwheat and corn, with milk albumin as the source of animal food, the egg yield has been rather small, with the advantage decidedly in favor of the corn.

It may be remembered that, in experiments carried out in 1899 and reported in our annual report for 1900, the comparisons between corn and wheat gave results decidedly in favor of the corn. A similar line of inquiry was continued during the years 1900 and 1901. A number of comparisons were made during these years between rations respectively rich in wheat and in corn, in connection with which in all cases beef scraps were used as the source of animal food. In the experiments of these two years, as in the experiment for this year, where beef scraps are used as the source of animal food the yields are slightly in favor of the wheat. It is not believed that we are yet in position to account for the difference in results made evident by the statements just given; but it is thought that a possible explanation is offered by the fact that in the tests comparing wheat and corn in 1899 animal meal was used as the source of animal food. The principal differences between such animal meal as we have employed and beef scraps are, that the animal meal contains the more mineral matter (undoubtedly derived from bone) and less fat than the scraps. It is the latter point especially which is believed to be significant. Corn is rich in fat; wheat is relatively poor in that constituent. With animal meal as a source of animal food, corn gave the best results. It has given the best results this year where milk albumin (which is still lower in fat than animal meal) is used as the source of animal food. And again, although this is less significant because buckwheat and corn differ from each other in marked degree in the amount of fibre they contain, we find the corn when compared with buckwheat, which is relatively low in fat, with milk albumin as the source of animal food, gives much superior results. It is fully recognized that the conditions determining the egg yield from a flock are numerous, and that the relation between the different nutrients in the rations

fed is only one, and possibly by no means the most important, of these conditions. It is, however, believed that the question of the proper combination of nutrients has its importance. It is recognized that the problems arising are difficult; but the investigations will be continued, in the full belief that the results of faithful work will prove of ultimate value.

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